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JULY 1942

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# AERONAUTICAL ENGINEERING REVIEW

VOLUME 1 JULY, 1942 NUMBER 4

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*Statements and opinions advanced in the Aeronautical Engineering Review are to be understood as individual expressions and not those of the Institute.*

George R. Forman, *Editor* Robert R. Dexter, *Managing Editor* Bennett H. Horchler, *Manager*

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# Gifts to the Institute by Mrs. Guggenheim and Glenn L. Martin

Two gifts were received by the Institute in June which will make it probably one of the most heavily endowed scientific societies in this country.

Mrs. Daniel Guggenheim gave her estate on Long Island which has an assessed valuation of $691,700.

Glenn L. Martin's gift of 25,000 shares of The Glenn L. Martin Company stock has a present market value of over $450,000.

In addition to these the Institute has The Paul Kollsman Fund of $65,000, The Sherman Fairchild Fund of $25,000, The R. H. Fleet Fund of $10,000, The Laurence Sperry Fund of $10,000, The Vernon Lynch Fund of $10,000 and The Benefactor Members Fund of $22,000.

### Daniel Guggenheim Park

On June 17, 1942, the announcement was made of the gift by Mrs. Daniel Guggenheim of her estate near Port Washington, Long Island, for the establishment of a center for aeronautical research and study as a memorial to her husband.

The estate is located on Sands Point and has two-thirds of a mile of waterfront. The main residence contains 40 rooms and overlooks Long Island Sound. Other buildings are suitable for laboratories and experimental investigations. The property of 162 acres has been named Daniel Guggenheim Park by the Council of the Institute. A Board of Trustees will supervise the Institute's program for the use of the property and will appoint a Board of Scientific Advisers to organize divisions to conduct aeronautical research.

In offering the estate to the Institute, Mrs. Guggenheim wrote the following letter:

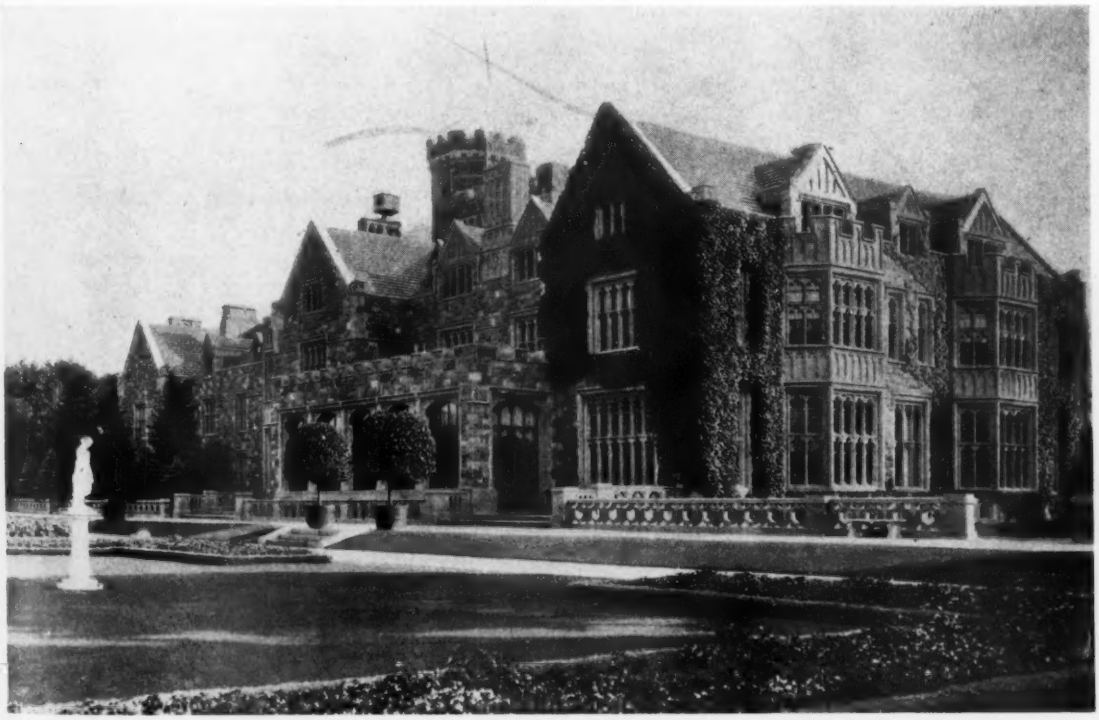
"I hereby offer to the Institute of the Aeronautical Sciences, Inc., my property near Port Washington, Long Island, comprising about one hundred sixty acres with two-thirds of a mile of waterfront on Long Island Sound.

"The buildings now on the property can be put to immediate use for laboratories, libraries and other purposes of the Institute.

"I would appreciate your discussing this offer with my son, Harry F. Guggenheim, and, if the Institute accepts, I shall be glad to transfer the property as soon as the necessary legal arrangements can be made.

"Obviously, I am no specialist in the art or science of aeronautics, but for a score of years aviation has been a familiar subject of discussion in my family life. No cause challenged more keenly the interest of my husband or my son, Harry. As you know, my husband, after mature study, founded the Daniel Guggenheim Fund for the Promotion of Aeronautics and my son, Harry, was its active President. Their enthusiasm was contagious, and I caught it, though not having their thorough knowledge.

"Of late, I have known the details of the conversations going forward between you and Harry about the Institute of the Aeronautical Sciences. I have great interest and faith in its work and even larger hopes for its future in view of the splendid plans formulated by yourself and your colleagues. It seems that my Long Island property meets the needs of the Institute for a location for its scientific projects. I know it would delight my husband, were he still living, again to render a service to aviation. Now, in his stead and memory, I have the privilege of making this offer."



The residence on the estate at Sands Point, near Port Washington, Long Island, to be used eventually for the Aeronautical Archives and Library.

### Uses of the Park

Major Lester D. Gardner, Executive Vice-President, explained some of the purposes for which the estate will be used.

"The gift of Mrs. Guggenheim will permit the Institute to make a direct contribution to the war effort by providing exceptional facilities for experimental aeronautical investigations by specialists. After the war, the Institute plans to advance the art and science of aeronautics by using the estate to enlarge the scope of its Aeronautical Archives so that its large libraries, collections of prints, photographs and other aeronautical material will be available to the aeronautical industry and others for research and experimentation.

"Provision could be made for Fellows in Residence and for scholarships as well as facilities for professors, engineers and others who might be on leave of absence from their regular work and would welcome opportunities for research and study. Here the scientist, engineer, physiologist, meteorologist and others interested in the aeronautical sciences will meet. By common discussion of their respective problems, they will be able to exchange information and offer suggestions which should be of great benefit to all phases of the industry."

### Acceptance Resolution

The Council of the Institute passed unanimously the following resolution:

*WHEREAS*, the Council of the Institute of the Aeronautical Sciences, Inc., has considered the offer of Mrs. Daniel Guggenheim to give to the Institute, unconditionally, in memory of her late husband, their former home, other buildings and real property at Sands Point, Long Island;

Lt. Comdr. Harry F. Guggenheim

Mrs. Daniel Guggenheim.

*AND WHEREAS*, the Council of the Institute believes that it can use the property so that it will contribute to the war effort of the nation and render a great service to the advancement of the art and science of aeronautics;

*THEREFORE BE IT RESOLVED*, that the Institute of the Aeronautical Sciences expresses its great appreciation to Mrs. Guggenheim for her generous gift and accepts it with the confident belief that it will benefit the aeronautical profession and be another evidence of the great devotion of Daniel Guggenheim to the advancement of aeronautics.

### Daniel Guggenheim's Interest in Aeronautics

The Daniel Guggenheim family has long been one of the most generous patrons of aviation in the United States. In 1926, the late Mr. Guggenheim established the Daniel Guggenheim Fund for the Promotion of Aeronautics with the deeds of gift totaling $2,500,000, subsequently increased by about $300,000. The Fund was to spend both income and principal to "promote aeronautical education throughout the country; to assist in the extension of aeronautical sciences; and to further the development of commercial aircraft, particularly in its use as a regular means of transportation of both goods and people."

Prior to the formation of the Fund, Mr. Guggenheim had established the Daniel Guggenheim School of Aeronautics at New York University with an endowment of $500,000. The Fund itself endowed schools of aeronautics or professorships at the Massachusetts Institute of Technology, Georgia School of Technology, California Institute of Technology, University of Washington, Leland Stanford University, Syracuse University and the University of Michigan. It also gave $250,000 for the establishment of the Airship Institute at Akron.

Among its other gifts were $140,000 for the establishment of a Chair of Aeronautics in the Library of Congress; an equipment loan of $155,000 in 1927, the first aviation equipment loan made in this country, to finance the establishment of a regularly scheduled aerial passenger service between Los Angeles and San Francisco; funds to establish the country's first complete aeronautical weather reporting service, also between Los Angeles and San Francisco; and a prize of $100,000 to that aircraft which demonstrated, under special rules, the greatest advance in safety.

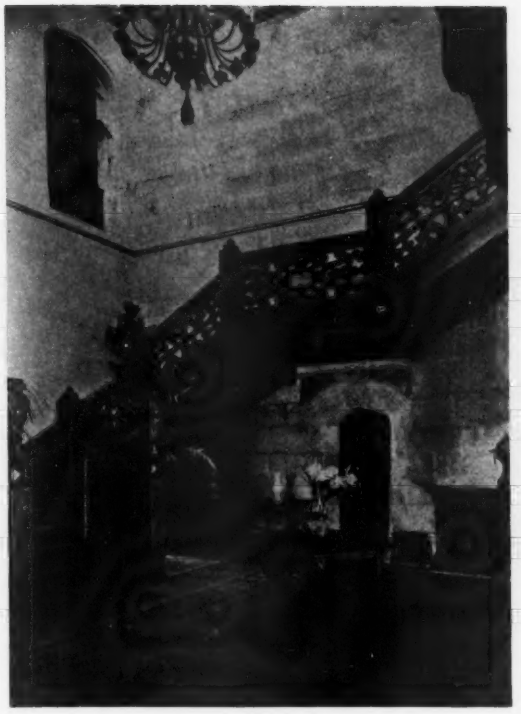
During the existence of the Fund, Harry F. Guggenheim, the son of the founder, was its president. He was a naval aviator during the first World War and is now on active duty again as a Lieutenant Commander, in the United States Navy. It was his enthusiasm for aviation that interested his father in aeronautics.

### General Doolittle's Experiments

It was at the request of Harry Guggenheim, as President of the Fund, that in 1928 the Army detailed Lt. (now Brig. Gen.) James H. Doolittle to establish a full flight laboratory at Mitchel Field, to conduct experiments in fog flying and to test and devise equipment for blind flying. In view of General Doolittle's recent feat in leading American bombers over Tokyo, it is interesting to note that the Guggenheim Fund Report of 1928 said: "His aeronautic achievements have placed him in the front rank of the nation's pilots."

On the morning of September 24, 1929, Lieutenant Doolittle at Mitchel

Daniel Guggenheim

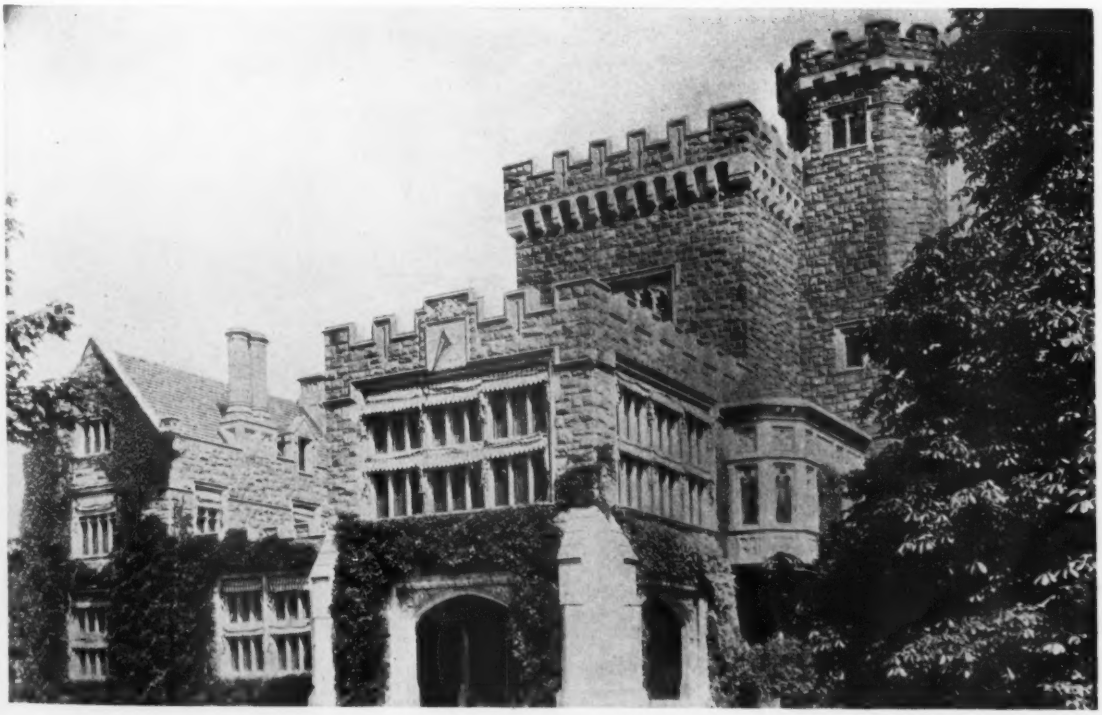


Entrance hall and stairway.

Doorway.

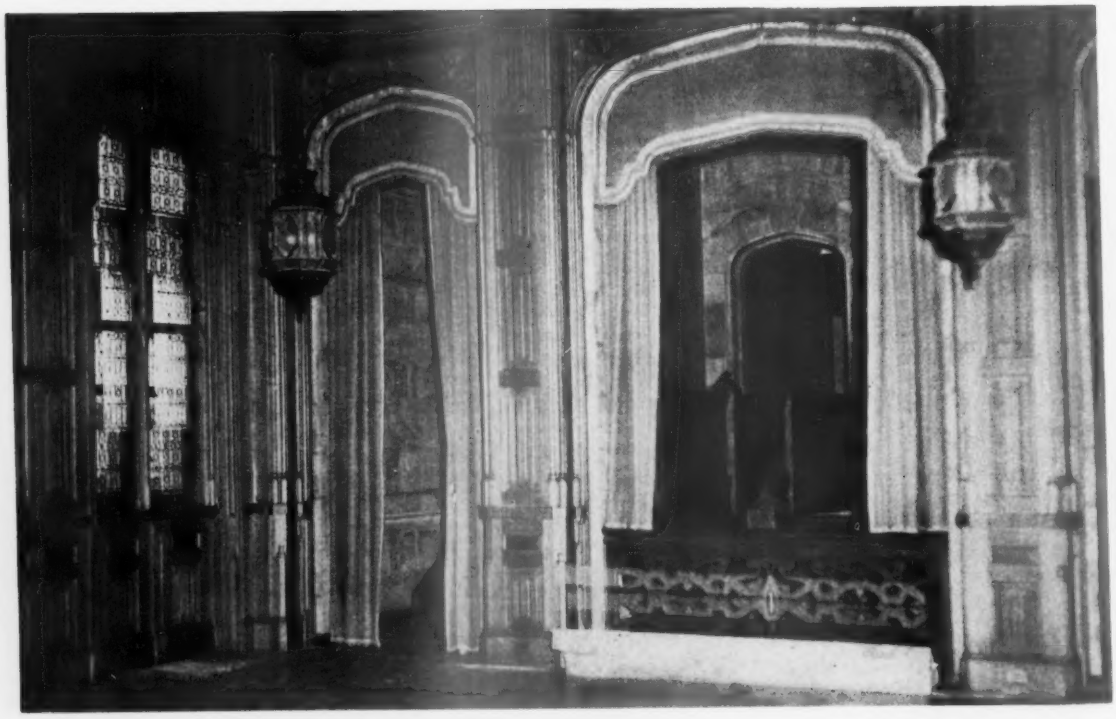
Field became the first aviator to fly "blind." Seated in a completely covered cockpit and guided entirely by his instruments, Lieutenant Doolittle took off from the field, turned around, recrossed it, turned again and came back, landing only a short distance from his starting point. He had flown about 20 miles and had proved conclusively the possibility of flying by instruments alone.

After his return from his epoch-making flight to Paris in 1927, Colonel Charles A. Lindbergh was employed by the Fund as its technical advisor. Under the Fund's auspices, he visited every state in the Union in his airplane, "The Spirit of St. Louis."

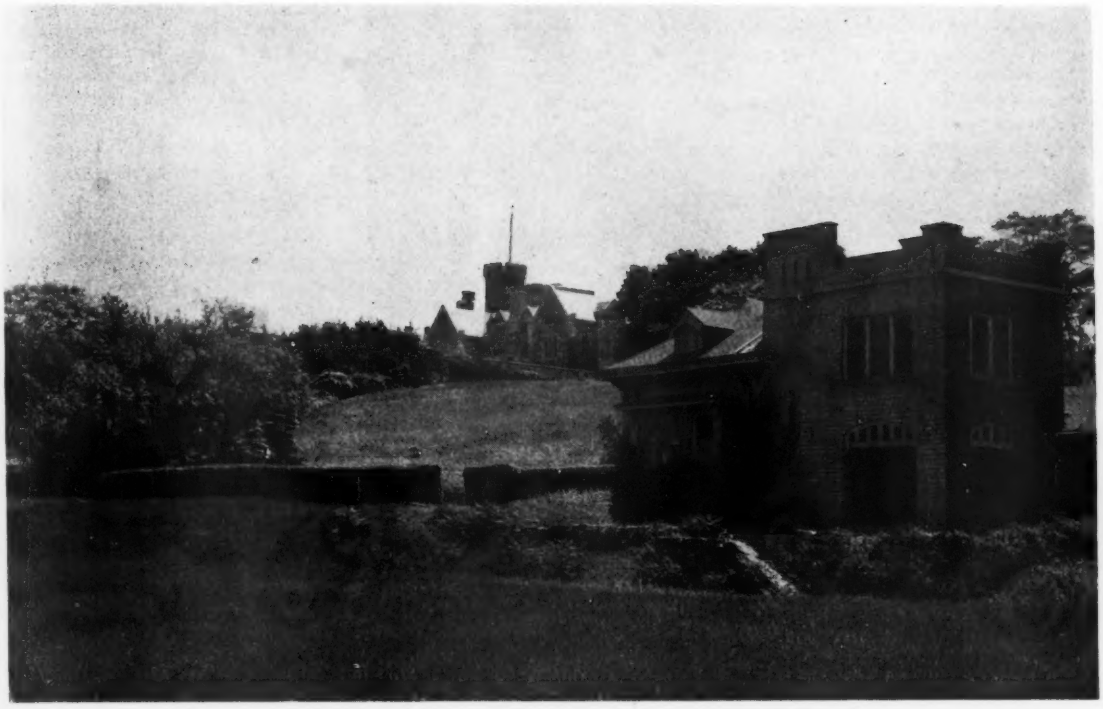


Main entrance of the residence.

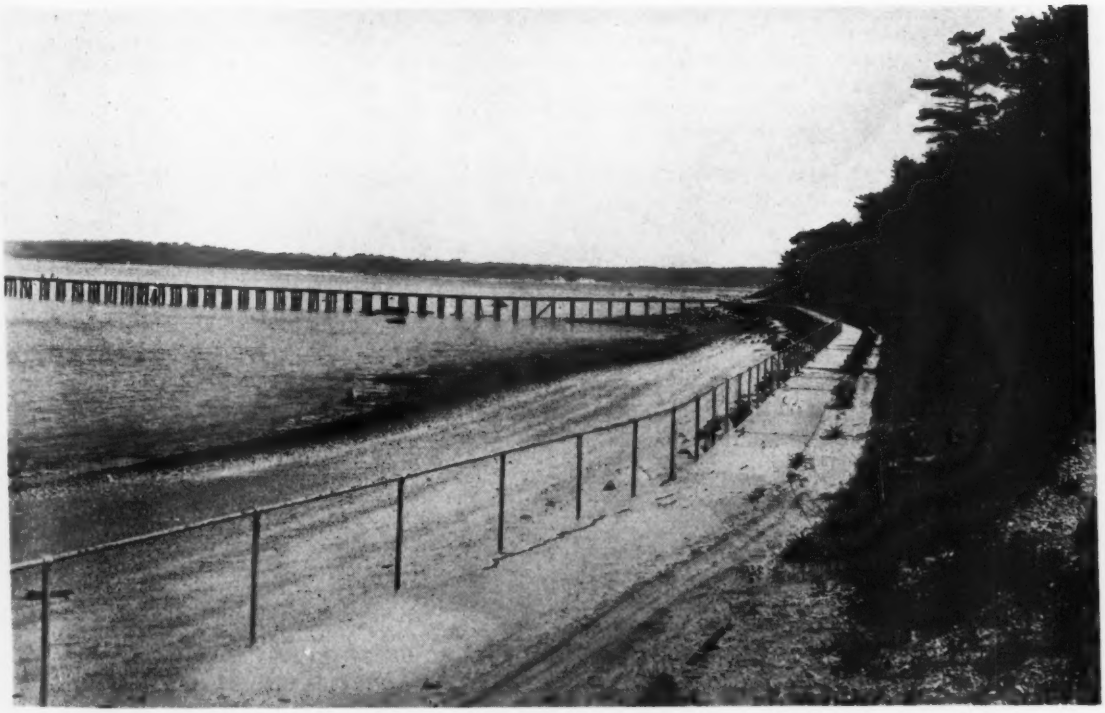
Interior court.



Corner of sun room.



View from shore showing enclosed swimming pool.



Sea wall and dock.

Shortly after the return of Commander, now Admiral, Richard Evelyn Byrd in his airplane, "The Josephine Ford," from the North Pole in 1926, the Fund with the cooperation of the Department of Commerce sent the airplane, piloted by the late Floyd Bennett, in a tour reaching 35 cities of the country.

### The Minta Martin Aeronautical Fund

Glenn L. Martin on June 18 handed to Major Lester D. Gardner 5,000 shares of stock of The Glenn L. Martin Company and agreed to give 20,000 additional shares at the rate of 5,000 shares a year for the next four years. The endowment will bear the name of Mr. Martin's mother, Mrs. Minta Martin.

In establishing this fund, Mr. Martin said:

"As aeronautical engineers have provided the basis for the fortunate growth of The Glenn L. Martin Company, I wish to show my appreciation by providing this fund to advance the art and science of aeronautics and to enable the Institute to take the first steps in using this valuable estate. It is my hope that others will also wish to assist the Institute in creating a great aeronautical center with laboratories, archives and libraries available for research and study. As my mother has for so many years been such a firm believer in the possibilities of the airplane, I hope that her expectation of even greater future developments will result from the uses made of this fund which bears her name.

Mrs. Minta Martin.

"As the effect on pilots of high-altitude flying is one of the great problems requiring intensive study, I hope that from the large laboratory building, which the Council of the Institute has named The Minta Martin Aeronautical Laboratory, developments will come which will make flying in the substratosphere more comfortable and safer for our combat pilots. It is also important that after the war passengers be flown at higher altitudes. If, from this fund, new knowledge can come which will solve some of these problems, I shall feel that this endowment has been put to excellent use not only for our war effort but in looking forward to the great use of the airplane when peace returns.

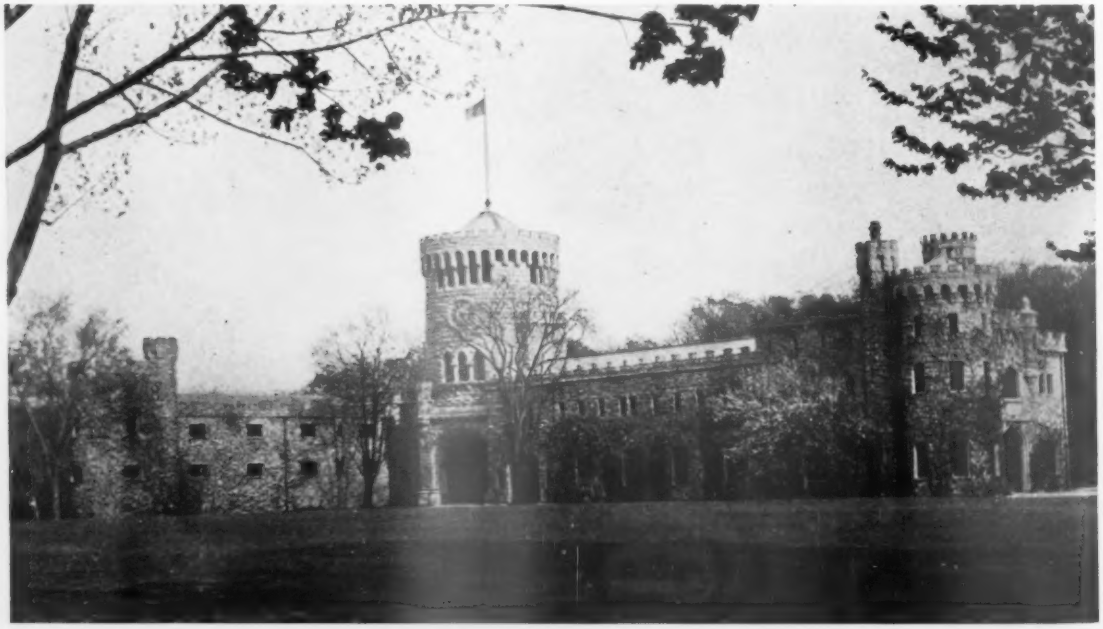
"I have given this fund with the confident belief that others who realize as I do the important results that can come from aeronautical research will also establish similar endowments for this and other purposes so that the Institute of the Aeronautical Sciences may make the fullest use of the great gift of Mrs. Guggenheim."

### Letter of Gift

In the letter of gift to the Institute Mr. Martin wrote:

"I have carefully reviewed your plans for expanding your usefulness during the war emergency and thereafter through the acquisition of the Sands Point estate of the late Daniel Guggenheim and establishing thereon an effective laboratory primarily designed for research in the wide field of aviation physiology, and I am in thorough sympathy with such a program.

"I understand that Mrs. Daniel Guggenheim has offered to donate to you the unrestricted title to and ownership of the Sands Point property comprising the Guggenheim estate recently occupied by her and her husband, the late Daniel Guggenheim, upon condition that, coincident with such donation, I effectively agree to donate to you during the five years 1942–1946 25,000 shares of the capital stock of The Glenn L. Martin Company; and, in fulfillment of this condition and in consideration of such donation to you of the Sands Point property, I hereby agree to donate to you in each of such five years 5,000 shares of the capital stock of The Glenn L. Martin Company, as a fund to be known as The Minta Martin Aeronau-



The Minta Martin Aeronautical Laboratory.

tical Endowment Fund and available to you for any purpose incidental to the maintenance and operation of the Sands Point property so donated to you and the creation, maintenance and development thereon of aeronautical research laboratories to be designated and known as The Minta Martin Aeronautical Laboratories, for the benefit of those persons engaged in aeronautics in the United States or the Government's activities in aeronautics.

"I have set aside and earmarked for the purpose of these annual donations 25,000 shares of my holdings of the capital stock of The Glenn L. Martin Company and, upon the transfer to you of the above-mentioned Sands Point property, I will cause to be delivered to you in transferable form certificates representing the 1942 installment of 5,000 shares of stock, and will thereafter cause to be delivered to you in transferable form, in each of the four succeeding years, 5,000 shares of such stock.

"I am making these commitments in commemoration of my mother's sympathetic assistance to and cooperation with me in my aeronautical activities over the past years and as a tangible recognition of my appreciation of your fine cooperation with the development of aeronautics in the past and the unlimited possibilities of your further cooperation in the future.

"Please be assured of my desire to cooperate fully with you in the development of this splendid program."

In accepting this gift Major Gardner said: "This endowment is one of the greatest gifts ever made to a scientific society. The Institute is grateful to Mr. Martin, one of its founders, a Past-President and an Honorary Fellow, for his generous gift which will permit it to render a service to the nation's war effort."

### Acceptance Resolution

The Council of the Institute passed unanimously the following resolution:

*WHEREAS*, Glenn L. Martin has offered to give to the Institute of the Aeronautical Sciences 25,000 shares of stock of The Glenn L. Martin Company, all as set forth in his letter to the Institute, dated June 18, 1942;

*AND WHEREAS*, Mr. Martin has agreed to give 5,000 shares of this stock to the Institute each year for the five-year period commencing with 1942;

*AND WHEREAS*, Mr. Martin is making this gift to provide the Institute with a fund to advance the art and science of aeronautics and to take the first steps in the use of the property given to the Institute by Mrs. Daniel Guggenheim;

*THEREFORE BE IT RESOLVED*, that the Institute expresses its appreciation for this large gift from Mr. Martin and designates it The Minta Martin Aeronautical Endowment Fund of the Institute of the Aeronautical Sciences.

Glenn L. Martin (right) giving to Major Lester D. Gardner 5,000 shares of stock of The Glenn L. Martin Co.

### Career of Glenn L. Martin

Glenn L. Martin, President of The Glenn L. Martin Company, which he founded in 1917, has been a manufacturer of airplanes since 1909. In that year he built his first powered aircraft and taught himself to fly. For many years he was one of the best known pilots in the United States.

He received The Collier Trophy in 1932 for the design and construction of the B-10, which was then the fastest bomber of its time. The Daniel Guggenheim Medal, conferred annually by representatives of the Institute of the Aeronautical Sciences, the Society of Automotive Engineers and the American Society of Mechanical Engineers in recognition of notable achievement in the advance of aeronautics, was awarded to him in 1940 "for contributions to aeronautical development and the production of many types of aircraft of high performance."

Mr. Martin was born in Macksburg, Iowa, January 17, 1886, and attended Kansas Wesleyan University. He received the honorary degree of Doctor of Science from this university in 1933 and the degree of Doctor of Engineering from the University of Maryland in 1939.

Glenn L. Martin was living in Salina, Kans., when he read of the early flights of the Wright brothers. He says of that time: "I was more excited than at anything I can remember. This was not aerial hop-scotch—it was sustained flight, at last."

It was to his mother that Glenn hurried with the newspaper—the mother who had encouraged him in his kite-building ventures in her kitchen. "I am going to fly, too," he said.

"Of course you will," his mother replied.

Later in 1905, when the Martins moved to Santa Ana, Calif., he sketched biplane designs and his mother was his only confidant. By 1908 the old Southern Methodist Church building, which had been abandoned for a new edifice, was used by Mr. Martin to build his first airplane. Into the church after dinner would go Glenn and his mother, to emerge late. This early close relationship between mother and son has continued ever since. When he was one of the country's leading pilots, she gave him every encouragement. Later, when he became an aircraft manufacturer, Mrs. Minta Martin could almost be called a "silent partner," her interest was so helpful. It is appropriate that her many silent contributions to the advancement of aeronautics in this country should always be remembered by the results that will come from the use of The Minta Martin Aeronautical Endowment Fund.

The exact uses to which the buildings at Daniel Guggenheim Park will be put cannot be announced until later, but when the plans that are now under consideration are made public, the Institute will be in a position to render a great service to aeronautics and the war effort.

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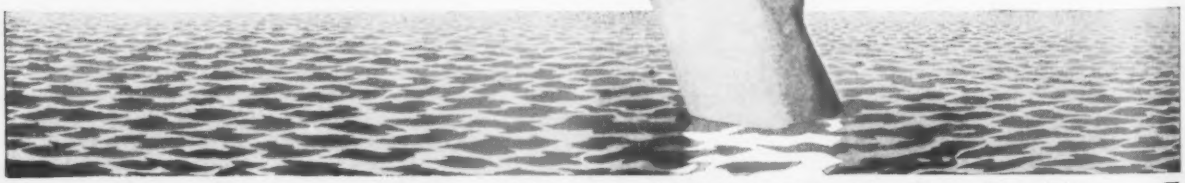
TRADE DOWMETAL MARK



# MAGNESIUM

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# Advances in Production and Assembly of Plywood in Aircraft Construction

HUGH G. BERSIE AND EDWIN R. CLARKE

*Haskelite Manufacturing Corporation*

SUMMARY

In this article the authors sketch the important changes that have occurred in the manufacture of aircraft veneer and aircraft plywood since the last World War. Special emphasis is placed on the value of aircraft plywood as a production material for emergency conditions. Design changes are described insofar as they refer to spars and wing ribs.

## INTRODUCTION

THE STRAIGHTFORWARD USE of plywood and wood in conventional, proved ways for the construction of military aircraft, particularly trainers, has a strong appeal to those primarily interested in reducing the total number of labor hours per airplane, and in increasing the number of airplanes that appear on the final assembly line at the end of a shift. Ease of tooling and the necessity of high-speed production are prime considerations. Ingenious methods of production control have been applied to a raw material of nature so as to provide a group of products which are remarkably uniform. It is the purpose of this paper to describe some of these developments in veneer, lumber and plywood and then proceed to sketch briefly the part that these products are now playing in the production of military aircraft.

## LOG SELECTION

Any improvement in the grade of aircraft logs must and does result largely from the ability to select logs most suitable for aircraft veneer and lumber. Unbelievable skill of this sort has been developed by certain men, but each man possesses that skill only for one or two species. One log buyer, for example, specializes in spruce alone. There are others who work in poplar alone or in mahogany or birch. Final selection must still be made, however, after the log has been "opened" by the sawyer or after it has been rounded up on the veneer lathe.

Presented at the Materials Session, Tenth Annual Meeting, I.Ae.S., January 29, 1942.

## CUTTING

After the logs are allocated for aircraft use there are two principal ways of cutting them into veneer: (1) rotary cutting; (2) slicing. Rotary cutting involves the rotation of the log in a huge lathe about its axis. The cutting knife feeds in toward the axis of the log, and the veneer is peeled off as one would peel an apple. Hence the name "peeler log" has come to denote one that is suitable for the manufacture of veneer. It should be pointed out to those in the aircraft industry whose knowledge of wood has been confined largely to timber for spars that spruce peeler logs are the same logs that would produce a high percentage of aircraft spruce spar lumber if sent through a sawmill. Slicing, on the other hand, involves the sawing of the logs into large timbers or "cants" which are then cut into veneer by a stationary knife. These cants are mounted on a large bed, similar to that of a metal planer, and this bed carries the cant past the slicing knife at an angle. The feed of the knife, in either the rotary or slicing process, determines the thickness of the veneer. The knife itself is not propelled except by the feeding mechanism. These same processes are used in the cutting of all veneer, but the need for accurate thickness control of aircraft veneer has caused heavier and heavier cutting machinery to be built so that deflections are kept to a minimum.

Preparatory to slicing or cutting, the wood in the logs or cants must be softened so that the veneer produced will not be rough or its grain ruptured. This softening is accomplished by placing the logs or cants in large vats of hot water. The period of soaking and the temperature of the water varies with each species of wood. This preparation of the wood is extremely important when aircraft veneer is to be produced. The speed of cutting must be carefully controlled. Almost all lathes and slicers are now equipped with variable speed motors, and the good operator takes full advantage of that fact. The result has been that sheet veneer can now be gauged as accurately as sheet metal, whereas formerly the thicknesses were so variable that anyone would flout even the idea of using a micrometer in a veneer or plywood plant. Now almost every such plant employs micrometers for a constant check of thicknesses.

## DRYING

Next to the cutting of aircraft veneer, the most important operation is that of drying. When the veneer comes from the slicer or lathe it carries an amount of water equal to 80 to 100 per cent of its dry weight which must be reduced to the 5 or 10 per cent range before its manufacture into plywood. During the drying process the veneer is flattened by what amounts to an ironing process in endless belt driers. In addition, many of the newer driers are so arranged that effective drying is accomplished at lower temperatures and at high-air deliveries, with a consequent improvement in the strength properties of the veneer itself. Because each species has different drying characteristics in addition to the different drying speeds for sapwood and heartwood, appropriate procedures have been developed for each. The matter of moisture content was formerly determined mainly by guess work, but in more recent years veneer drying plants use the modern and convenient electric moisture meter.

## TESTING

Tensile veneer testers have aided in the selection of high-strength veneer and the elimination of below-standard material. Visual inspection alone has proved to be unsatisfactory. As a general rule, the plainest of straight-grained wood is the best for aircraft and the least suitable for furniture. Economically, therefore, the two uses work well hand in hand for such decorative woods as walnut and mahogany and to a lesser extent for birch. Beautifully striped mahogany or the highly figured "fiddle back" commands a high price in the furniture market, but its low strength makes it impractical for use in aircraft.

While a calibrated tensile tester is highly desirable for checking the strength of veneer, at the same time considerable information may be obtained by bending strips of the veneer

over a long conical surface having end diameters of, for example, 6 in. and $1^1/_2$ in. The narrow strip of veneer to be tested is simply bent over this cone at the large end and then slid along the cone until it fractures in bending. The diameter of the cone at that point is recorded as a relative measure of the strength of the specimen. If one takes a sheet of ribbon mahogany and cuts it into narrow strips corresponding to the ribbons, one can see the vast difference in strength between the straight-grained ribbons and the adjacent strips in which the grain goes in and out of the plane of the veneer at a sharp angle of inclination. The same test also shows the marked difference in strength properties between new wood and that in which a peculiar brown stain indicates incipient decay.

### Bonding

Concurrently with these improvements in the manufacture of veneer, the technique of making plywood has progressed continuously since the last World War, when blood and casein glues were the best obtainable. One of the most publicized advances in plywood manufacture was the changeover from these protein glues to the moldproof synthetic resins. Initially, phenol formaldehyde resins were employed in liquid forms either as varnish solutions or as colloidal dispersions. Later on, glue film became available in this country. It is a thin paper carrying phenol formaldehyde resin of a thermosetting type. This film is now used universally for aircraft plywood. But to improve plywood in this one respect and to neglect other equally important characteristics would obviously be shortsighted. If plywood is manufactured from poor veneer, then the high quality of the glue bond will never save it from being a weak material. In fact, if an airplane manufacturer had the choice of buying a protein-glued panel made from high-strength veneer as against a resin-glued panel made from inferior veneer, he would be much better off with the first choice. To implement the day-by-day selection of high-strength veneer of uniform quality, it is necessary that the control equipment be out on the production line and not in the laboratory; it is also necessary that the workmen and inspectors assume the responsibility of this job of selection—it cannot be relegated to the laboratory or research departments that, at best, can give the matter but meager attention.

### Specific Gravity

While tensile and bending tests are of great importance, there are other convenient tests of great value. One of these concerns the specific gravity of the wood. Almost all species show rather wide swings in density, but fortunately the great percentage of each species falls within a narrow range. In other words, the rejection of a few per cent of exceedingly high or extremely low density lots will eliminate wide variations in densities. As has been frequently pointed out, the density and strength characteristics of wood are closely correlated. Tests made at Forest Products Laboratory and reported on page 37 of *Technical Bulletin No. 479* reveal that for 163 native species: $F_1 = 16{,}700 \times G^{1.25}$ and $F_2 = 8{,}750 \times G$, where $F_1$ is the fiber stress in pounds per sq.in. at the elastic limit in bending, and $F_2$ is the fiber stress in lbs. per sq.in. at the elastic limit in compression parallel to grain, and $G$ is the specific gravity, oven dry, based at volume at 12 per cent moisture content. Fortunately, specific gravity is a property that is easy to determine. A piece of low density spruce, for example, is detected instantly by a good wood inspector.

### Humidity Control

When the veneer starts on its way from the drier to the hot press there are many opportunities for its moisture content to change during this long process, and especially during that portion of the time it is exposed to the air while being handled. Therefore it is of great importance that there be humidity control in the veneer room. Veneer, like all cellulose products, has a moisture content that depends upon surroundings —i.e., after a time it assumes a definite moisture content which is an equilibrium value for the relative humidity of the space in which it is placed. Consequently, if the veneer comes to the veneer room with its moisture content between 6 and 9 per cent and if it is desired to preserve this range, then the relative humidity at normal temperatures must be kept in the range of 40 to 50 per cent. Closer control is not necessary, and this degree of control can be obtained with simple apparatus. This control is necessary in an aircraft plywood plant all along the line, up to the time the veneer sheets are bonded together in the hydraulic press. Humidity control not only gives better glue bonds —e.g., the average shear values went up nearly 10 per cent in one plant after humidity control was installed—but it also produces flatter panels. Suppose, for example, that a mahogany-poplar panel is glued with $^1/_{48}$-in. mahogany faces and $^1/_{28}$-in. poplar core so as to produce a panel of $^1/_{16}$-in. nominal thickness. Assume that one face has a moisture content of 10 per cent and the other 5 per cent at the time of gluing.

Subsequently, the two faces will arrive at the same moisture content, which is assumed to be 10 per cent. The face that was originally at 5 per cent will obviously expand except insofar as it is restrained by the core. The panel thus becomes unbalanced just as if the two faces were of different species or of different thicknesses—a construction that has never been permitted by any aircraft specification. Such panels show a tendency to warp and buckle, and this tendency appears to be most pronounced in thicknesses ranging from $^3/_{16}$ to $^3/_8$ in., which involve five plies. The solution is found in humidity control for the plywood plant.

### Clipping, Edge Jointing and Edge Gluing

As the veneer moves toward the press it goes through clipping, edge jointing and edge gluing operations. Here new and more efficient machines have been perfected. Special emphasis has been placed on the edge jointing and edge gluing operations. Rarely is it possible to obtain veneer wide enough so that a core or a face ply may be made of one single sheet. First, defects must be clipped out and the edges trued up parallel to the direction of grain. These operations greatly decrease the width of the veneer. After coming from the clipper, the edges of the veneer must be trued up accurately on a veneer jointer that produces a smooth edge that is straight within a few thousandths of an inch. The manufacturer of one jointer, for example, guarantees an accuracy of 0.003 in. in a 16-ft. length of edge. Then after the jointing operation the veneer strips are edge-glued together to form a single sheet somewhat larger than the size of the completed panel. Formerly the operation was performed on a taping machine, but modern plants accomplish this result by means of the so-called "tapeless taper." The importance of the operation is shown by the fact that it accounts for approximately one-third of the total labor cost of producing a three-ply aircraft panel. The elimination of tape, except for repair purposes, was a great improvement. Paper tape, although removed later, always left its imprint in the faces of the panel except where the faces were thicker than $^1/_{32}$ in., in which case both the tape and the imprint could be removed by sanding. Such tape marks almost always showed through the finish, and the water-soluble hide glue sizing remained on the panel's surface in such a way as to endanger the strength of any glue joint that might be made at this spot in the process of aircraft assembly. This ingenious veneer splicer consists of a series of converging rollers and a caterpillar drive in conjunction with heated platens. Thus, heat and pressure are simultaneously applied to the veneer as it passes through the machine at a speed of 15 to 75 ft. per

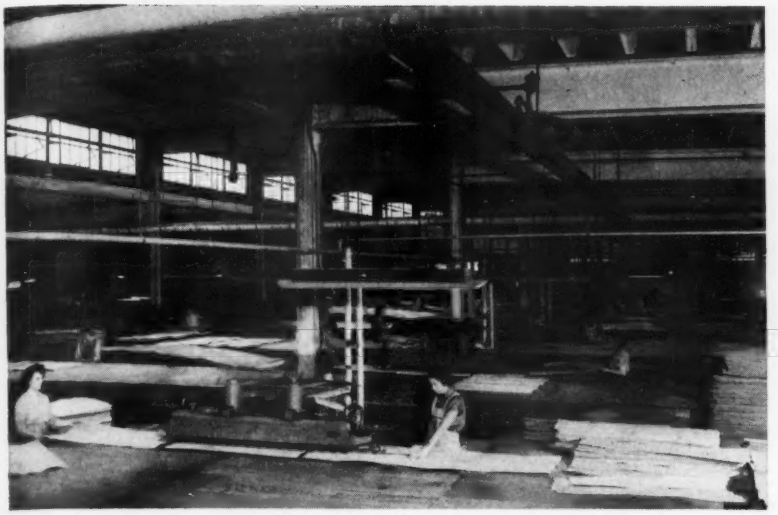

FIG. 1. View taken in aircraft plywood plant showing splicing of aircraft veneer by battery of steam-heated continuous edge gluing machines. Note the automatic humidifying units located overhead.

min. The glue has been previously applied to the edges of the veneer. Since this series of rollers is from 5 to 6 ft. long, the glue must be of a type that can be "set" or cured in from 4 to 20 sec. The outstanding feature of these machines is their ability to handle stock as thin as $^1/_{100}$ in. and as thick as $^1/_8$ in. (Fig. 1).

### SPECIFICATIONS FOR AIRCRAFT PLYWOOD

When a structures engineer selects 0.080-in. 24ST aluminum sheets for the shear web of a spar, he knows that the supplier will make them of uniform strength properties and will provide the proper thickness of pure aluminum coating. It is recognized that a high degree of uniformity is found in such materials as a result of standardization and highly refined specifications. If the same engineer, for example, were to select $^1/_4$-in. five-ply yellow poplar plywood for shear webs and if he knew of the lack of uniformity that exists in the manufacturing practices throughout most of the aircraft plywood industry, he would be confronted with real problems that can and should be eliminated promptly. He might realize that if one company makes the panels they will have $^1/_{20}$-in. veneers for the face and back plies, $^1/_{23}$-in. veneers for the crossbands and $^1/_{13}$-in. veneer for the core, whereas if another company makes them they will have $^1/_{20}$-in. veneers for the face and back plies, $^1/_{14}$-in. veneers for the crossbands and $^1/_{20}$-in. veneer for the core. The plywood panels from these two companies have radically different strength properties, yet both panel constructions mentioned will meet the existing Government aircraft plywood specifications. This is only one instance of the serious shortcomings of the present aircraft plywood specifications.

A proposed specification for structural aircraft plywood has been prepared and is available on request.* This has resulted from the efforts of several aircraft manufacturers and of one manufacturer of aircraft plywood. It is based upon their own experience and upon suggestions from several Government engineers who are interested in this subject. This specification, while imperfect in certain details, was prepared only after a thorough study of thousands of tensile shear tests made in accordance with the American specifications AN-NN-P-511.

* Aircraft Plywood Specifications No. 12, 11 pages, illus.

It is the opinion of the writers that this specification cannot be further modified without a long series of tests. The specification has been in use long enough to prove its worth. The specification does not eliminate all variation in constructions between different manufacturers. For the duration of the present emergency the writers favor the adoption of a rigid system of uniform or standard constructions for use throughout the industry so as to facilitate rapid production.

### HOT PRESSING

During the last War much of the aircraft plywood was produced by the cold process, but in recent years the hot method has become universal. Most of the presses are steam-heated, but the electric press has steadily gained favor. Steam presses are made with a multiple number of platens and openings because only one panel can be glued between each pair of platens (Fig. 2). Consider the productive capacity of a steam press gluing five panels 60 by 120 in. at a time. If the panels are $^1/_8$ in. thick, the gluing time with sheet film glue will be five min. In an eight-hour shift the press would be closed about 60 per cent of the time so that 285 panels, or 14,250 sq. ft. of plywood, would be produced.

The electric press is specifically designed to glue a large number of panels in stack formation at one time. It involves flexible heating elements. The elements are interposed between the panels to be glued, and because of their flexibility they permit uniformity of gluing pressure without excessive wood compression, even though the veneer varies in thickness from point to point. This press has an enormous capacity

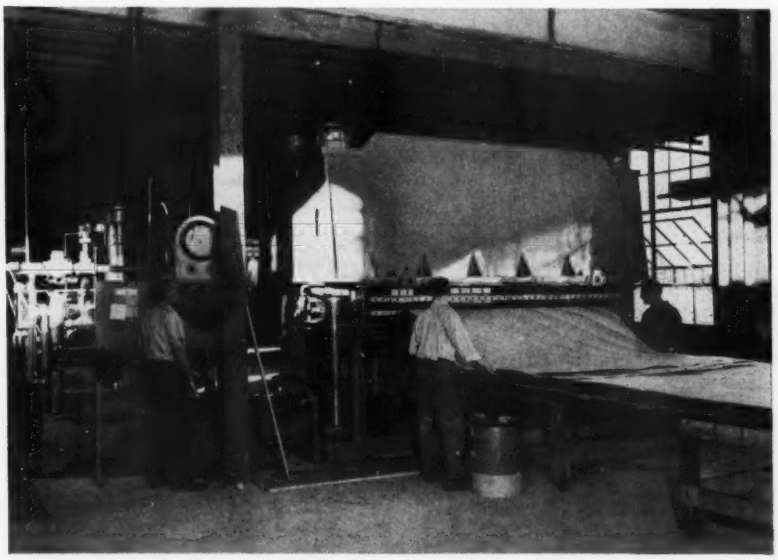

FIG. 2. Steam-heated hydraulic press being used in the production of aircraft panels.

**FORD**
Pratt & Whitney Engines ★

**BUICK**
Pratt & Whitney Engines ★

**CHEVROLET**
Pratt & Whitney Engines ★

**NASH-KELVINATOR**
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**CONTINENTAL**
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# 10

## great manufacturers team up with UNITED AIRCRAFT

Engines, propellers and airplanes are among the items of equipment most vitally needed by our armed forces. The faster they can be made, the sooner this war can be won.

United Aircraft recognized this fact as far back as the summer of 1940, and started enlisting other manufacturers as emergency production sources. Under this program ten great manufacturers, whose names are household words, have teamed up to build several billion dollars worth of Pratt & Whitney engines, Hamilton Standard propellers and Vought-Sikorsky airplanes *per year*. This emergency production will be without profit to United Aircraft, which has gladly contributed its proven designs, technical experience and manufacturing "know-how."

This foresight is bringing results today. Precious months have been saved. A number of these manufacturers are already shipping engines and propellers in quantity, and the others are rapidly gearing up for production.

All this is in addition to United Aircraft's own vastly expanded production, which has increased many fold since 1940.

This teamwork typifies the cooperative spirit of American industry in this emergency, about which the *New York Times* says:

*"The whole manufacturing picture with regard to aircraft is an encouraging example of American industrial spirit rising to meet an emergency, with full cooperation and interchange of design, personnel and equipment between previously competitive elements within the aircraft industry and the automobile industry, and between the two great industries themselves."*

In enlisting the full-out efforts of these ten organizations, United Aircraft has helped to create what is probably the greatest manufacturing team the world has ever known.

**UNITED AIRCRAFT CORPORATION**
EAST HARTFORD • CONNECTICUT

Pratt & Whitney Engines

Vought-Sikorsky Airplanes

Hamilton Standard Propellers

(Fig. 3). The usual load is 23 panels, 74 by 98 in., rough size, so that one electric press has as much capacity as four or five steam presses. Recently, some success has been obtained with the use of high-frequency electrostatic fields for the gluing of commercial plywood in stack formation at somewhat lower temperatures.

### Plywood Design

During the last World War, plywood was used in aircraft structures in combination with steel and wood frames, wire bracing and fabric covering. The majority of these ships were biplanes with low-wing loadings, wherein plywood entered the structures as a means of maintaining the contours of the wings' leading edges. In addition, plywood was used for rib gussets, wing walks, compression ribs and, to a limited extent, box-type fuselages. Along with the advent of the monoplane came the cantilever wing and much higher wing loadings. These changes brought about the rapid development of stressed skin aircraft structures. It was with these changes that aircraft plywood was recognized by some as the ideal production material for stressed skins. Aircraft designers working with stressed skin sheet metal structures found that even on fairly large airplanes the metal skins could not be stressed to a figure even remotely approaching its actual yield strength because the skins became so thin that premature failing occurred by buckling or wrinkling. To prevent this it was necessary to rivet on many secondary stiffeners or stringers on the back of the skins, all of which increased weight and cost. But with plywood its use as stressed skins allows the employment of thick panels, free from buckling without extensive reinforcing.

For that period of years when the all-metal airplane vogue was at its peak, experimental work and the small-scale production of planes using plywood construction went on almost unnoticed; however, it was this work, carried on for the last ten years, that gave plywood a flying start at the outset of the present emergency. A vast amount of practical data was collected, and new types of plywood constructions were developed for specific applications.

Normally, the major portion of this activity can be carried on by the use of flat panels applied to the structure with or without the necessity of preforming these panels to single curvatures. Die gluing has never come into extensive use because of the extremely high cost of accurately machined dies required to bond veneer together in this fashion. But much progress has been made along this line with steam tanks wherein, through the use of a flexible blanket, heat and pressure are simultaneously applied to the assembly.

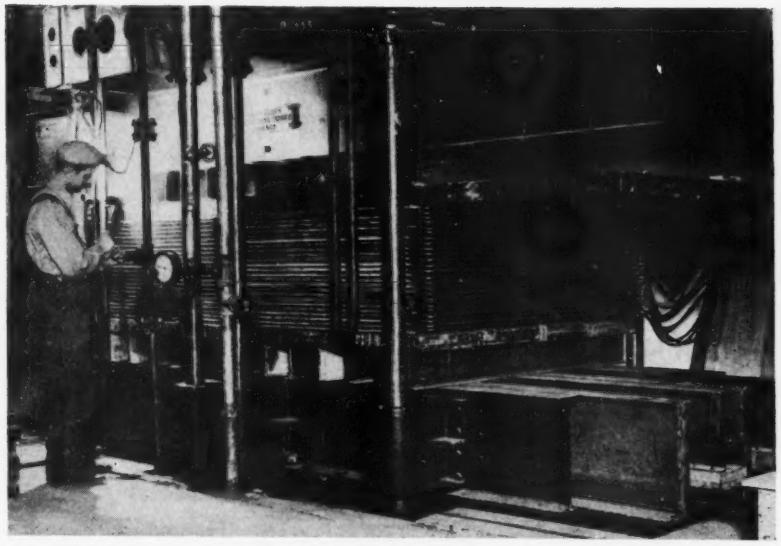

Fig. 3. Electrically heated plywood press using flexible heating elements. Permits the gluing of a stack of panels at one time.

### Factory Tooling

Since wood airplanes can readily be built without many special tools or fixtures, in the past that part of the plant equipment was often neglected, partly because of a desire to save money, and because the designers wished to avoid "freezing" the design. Recently there has been a marked swing toward power equipment and specially built fixtures for wood airplanes. Spars that used to be shaped by hand are now machined and contoured almost solely on large, accurately built fixtures with power-driven high-speed shaper heads. In a typical case the labor hours per spar were radically reduced to one-fifth of the former number. The accuracy, of course, is greater with these fixtures, and the required floor space is reduced.

A number of plants have perfected simple but effective fixtures for the wing panels, vertical fins, horizontal stabilizers and wing ribs. A few years ago the standard practice in building plywood wings was to assemble them in a horizontal position on makeshift wooden horses, but now many are being assembled in rigid metal jigs that hold the wing in a vertical position, thereby allowing the workmen free access to both the top and bottom of the wing at one time. These vertical jigs take up only 25 per cent of the floor space required by the old horizontal method of assembly. The whole design of wing ribs has undergone radical changes in order to facilitate their rapid manufacture. One of the principal changes is the use of continuous gussets to eliminate the handling of a number of small individual gussets, each not much larger than an air-mail stamp. With the adoption of the continuous gussets—two paralleling the top spruce cap strip member and the other two the bottom—the weight of the rib is increased but a small amount and a strength advantage is gained through the stiffening of the spruce members. Now certain plants are carrying this procedure a step further and are gluing these gussets to the spruce by means of a thermosetting resin and a hot press. Nailing is eliminated. The rib members are assembled in fixtures made of thin metal plates. They are comparatively simple fixtures and easy to handle. In a typical case the fixture stays in the press only two min. The quality of gluing is better than with nailing, and the labor minutes per wing rib are reduced to an amazingly low figure.

### Fixtures

The building of the fixtures for a plywood and wood fuselage is much simpler than the comparative massive construction demanded for metal structures. The plywood panels are normally supplied in flat form, and when the fuselage is skinned the panels are simply pulled over the frame members without the necessity of preforming them to shape. Fuselage rings are often routed to shape from flat sheets of $^{5}/_{8}$- to 1-in. thick plywood; nesting is planned so as to reduce waste. Static tests show a truly amazing ability of such fuselages to carry high design stresses without signs of any local skin buckling.

While special fixtures for wood aircraft are important in a production plant, one should not neglect to mention the progress made by manufacturers of

**IN 1921**

this commercial version of the MB-2 (the original Martin Bomber) introduced the plastic nose section, utilizing a transparent cellulose plastic.

# Pioneering in Plastics

## on a 1921 Martin Transport

No hasty wartime improvisation is the plastic nose now standard on nearly all American bombers. As early as 1921 The Glenn L. Martin Company commenced experiments with cellulose plastics, giving aviation its first transparent plastic nose section. From these early experiments, and the years of unremitting research that followed, has come the tough, clear acrylic nose of the Martin B-26 . . . the first *all*-plastic nose section made without metal supporting members to hamper visibility. Less than half the weight of glass, quickly formed and easily worked, this Martin plastic nose offers high resistance to weather, temperature variances and fierce air pressure, as well as absorbing gun-recoil. But this is only half the story of Martin plastic research. One type of 1942 Martin bomber contains more than 400 plastic parts to save aluminum, reduce weight, and speed production. Today, as since 1909, Martin pioneering is paying dividends to the entire aviation industry.

The Glenn L. Martin Co., Baltimore, Md., U. S. A.

**Martin**
**AIRCRAFT**

*Builders of Dependable Aircraft Since 1909*

**20**
**YEARS AFTER**

the introduction of the pioneer plastic nose, the all-plastic warhead of a Martin B-26 gives full forward hemisphere visibility to increase efficiency in both attack and defense. Smaller plastic gun emplacements guard rear and upper hemispheres with heavy firepower.

FIG. 4. Dipping vat employed for moisture-proofing of the complete wing.

woodworking machinery of standard design. Straight line rippers, high-speed planers, shapers, routers, multiple boring machines, band saws, cut-off saws, power-operated glue spreaders, hydraulic presses and scientifically operated dry kilns have all contributed to the control of production and to accuracy and speed. Where metal airplanes are produced, heat-treating equipment is normally found; it is important to give wood and equal opportunity by providing kiln capacity for lumber and by supplying humidity control throughout the woodshop. Companies that have appreciated this point of view and have given wood a fair break have been amply rewarded by the good number of completed airships that appear on the delivery line each month.

### PROTECTIVE FINISHES

Wood and plywood do not present any unusual problem with regard to protective finishes, although much has been heard to the contrary. In reality, wood is inherently easy to finish, and decay is almost unheard of where the simplest precautions are observed. As with metal, there is need of providing ventilation for enclosed or boxed-in spaces. Dipping of completed parts has been incorporated into at least several production lines. The paint companies have cooperated splendidly by having their laboratories make a control analysis of the solutions each week. Dipping is a labor-saving procedure and, of course, every obscure part that needs a protective coating is reached (Fig. 4).

### PRODUCTION EXPANSION

Plywood manufacture can be easily expanded to a high peak of production. The English were quick to realize that fact well in advance of their emergency. Their Miles Master, Miles Magister, Oxford Air Speed and Avro Anson are all plywood aircraft which were produced in great volume on short notice.

Timber for aircraft purposes is available in good quantity. The necessary labor is there. The productive capacities of veneer and plywood can be easily expanded. Skilled woodworkers from furniture centers can be utilized satisfactorily without jeopardizing activities that involve metals. This age has become known as an age of metal, and the normal balance has been lost through a failure to appreciate that wood, after all, fills many of the important requirements for an ideal aircraft material. When one stops to realize that a tree can be felled and in a relatively short time be in the airplane in the form of plywood, the speed in comparison with the relatively long time required to transform ore through all the various processes of alloying, heat-treating and rolling into completed metal sheets can be appreciated.

There is no other material that offers the same speed. The merits of plywood obviously cannot be fully appreciated if an aircraft plant is tooled up solely to produce metal airplanes. In this case a plant or department might easily be set up for wood construction with the appropriate personnel. Quick results can be obtained this way, as has been demonstrated many times.

To be given a fair trial, wood should be used throughout a good portion of the airplane. Plywood is an easy material to handle and is readily available.


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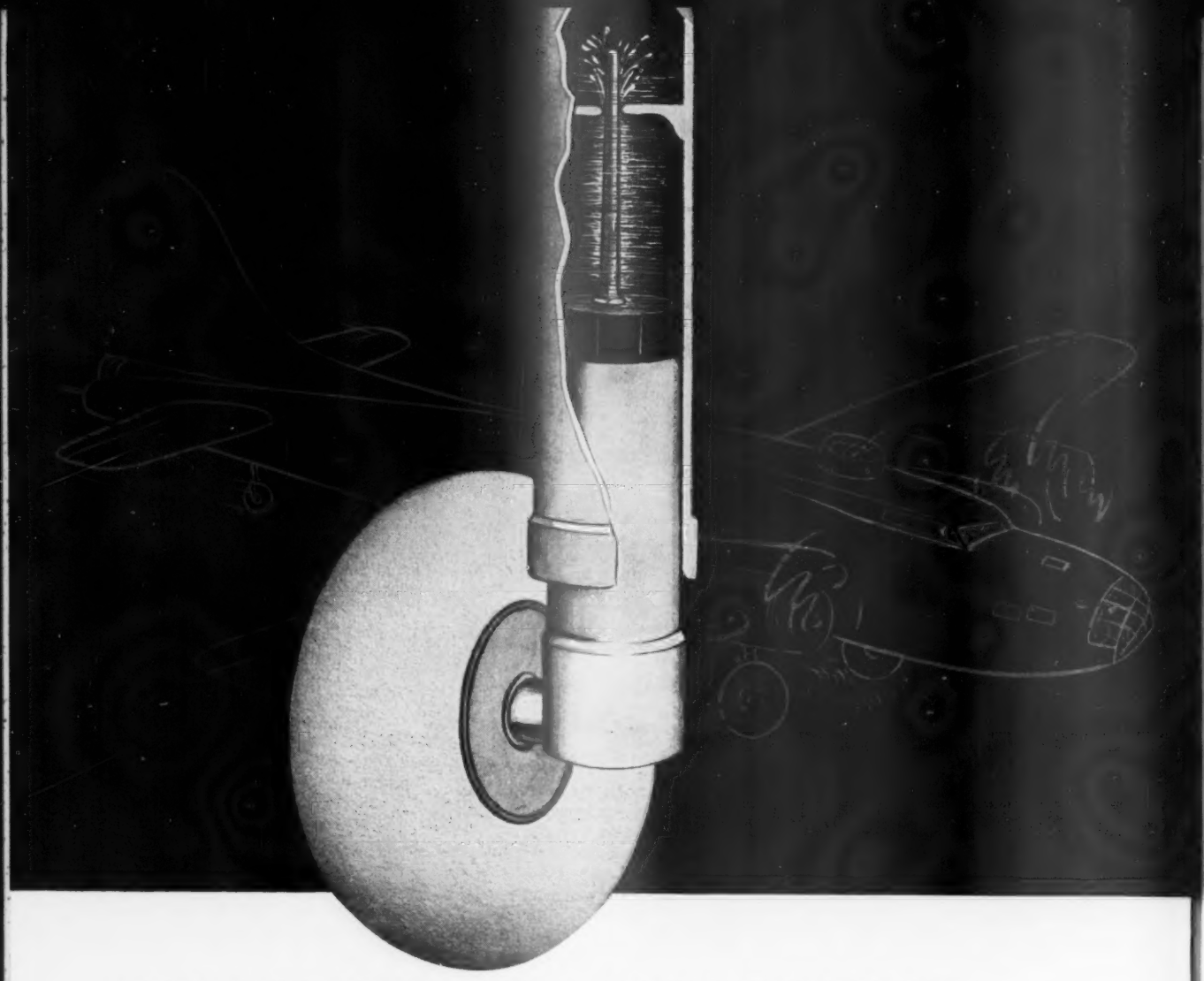

# FIGHTING OIL MOLECULES *insure* SAFE AIRPLANE LANDINGS

**Eighteen years ago the landing of airplanes was revolutionized by the introduction of a new shock absorber called the Aerol Strut. The Aerol Strut transmits the force of the landing impact on the wheel into a cylinder filled with oil. Under intense pressure the molecules of oil fight with each other to escape from the cylinder through a small exit. The size of this exit is regulated by a metering pin. The struggles of the molecules dissipate most of the energy created by the shock of landing. Consequently, the plane rolls over the ground without bumping or jolting.**

**This type of landing gear quickly demonstrated its superiority over anything then in use. As a result, more Aerol Struts have been installed on airplanes than any other kind made.**

**But the engineers who designed Aerol Struts are not resting on their past laurels. While supplying struts for today's warplanes, they are continuing their research, developing vital improvements. When peace returns, when air transportation becomes a still greater mode of travel, Aerol Struts will continue to contribute to the progress of the aviation industry.**

**THE CLEVELAND PNEUMATIC TOOL COMPANY,** AIRCRAFT DIVISION CLEVELAND, OHIO

CONTRACTORS TO THE UNITED STATES GOVERNMENT

Also manufacturers of Cleco pneumatic tools for the aircraft industry, Cleco sheetholders, Cle-Air shock absorbers for trucks and buses, and rock drills for mining and construction work.

AEROL *Shock-Absorbing* STRUTS

FIRST CHOICE OF AMERICAN AVIATION TO KEEP 'EM LANDING SAFELY AND SMOOTHLY

# Control Procedure of Torch Welding in Aircraft

**ERIC DUDLEY***

***Curtiss-Wright Corporation***

## Introduction

Since torch welding is a manual operation in which the quality of the finished product is entirely dependent upon the skill of the operator, it becomes necessary in aircraft work to establish definitely a control procedure that will assure sound welds. In order to establish such a procedure, consideration should be given to many phases of welding which are not directly associated with the actual operation itself. For instance, careful consideration of detailed airplane design as related to welding procedure, together with a thorough knowledge of tool and fixture design, is equally as important to welding control as the welding process itself.

The purpose of this paper is not to discuss the properties or the appearance of welds, but rather to outline the control under which it may be expected that consistently sound welds can be produced. The importance of a basic metallurgic knowledge by production welders cannot be too strongly emphasized. The method of creating this knowledge will be outlined in detail.

## Detail Description

### *The Welding Engineer*

In order to establish a satisfactory welding procedure, it is necessary to train a welding engineer who will assume the responsibility of control. This engineer, of necessity, must have many qualifications. He must have a reasonably good knowledge of metallurgy, both ferrous and nonferrous, he must have more than the usual knowledge of jig and fixture design, and he must be an exceptionally skilled welder. Above all, he must be diplomatic and cooperative in his attitude. The success or failure of any welding control is dependent upon this one man.

It is believed advisable to have the welding engineer report directly to the Engineering Department for these three reasons: first, because this places him in a position to control the types of welded joints incorporated into experimental design, thereby giving him a long-range view in assisting the Tool Design Group in planning tools and fixtures long before the parts reach a production stage; second, it affords unrestricted use of laboratory research facilities; and, third, it tends to eliminate any short-cutting that might develop through the desire to increase production at the expense of sacrificing welding quality.

To appreciate better the functions of the welding engineer, take the example of an all-welded air-cooled engine mount ring. After aiding in advising the Experimental Engineering Section concerning the types of joints best adaptable to the engine mount in question, the welding engineer recommends tooling practice and then actually proceeds to aid in the fabrication of the experimental article, following it through the various departments—Magnaflux, Inspection, and Heat Treat—when required. Upon the completion of this part enough data have been obtained to assure that the fabricating shops can proceed with the welding of production parts in quantity lots.

Usually a man possessing qualifications of this type is rather difficult to obtain. Therefore it becomes necessary to select a certain individual and, over a protracted period of time, train the man to the position.

### *Training of Welders*

Since torch-welding operations constitute the metallurgic problem of melting and recasting metal, it has been found advisable to have the welding engineer select groups of welders and form them into classes. To these classes the basic metallurgic principles of the materials to be welded are outlined. This has been found to be a satisfactory method of creating individual interest in producing structurally sound welds and imparting to all welders a sense of knowledge and interest in their work which would otherwise be lacking.

When hiring welders who have not had any past airplane experience, the usual practice is to restrict them to practice welding for a period of a few days in order to permit them to overcome any nervousness and at the same time familiarize themselves with the equipment. Before any welder is hired, he is submitted to a welding test given by the welding supervisor so that the welder's technique in adjusting the welding flame, tacking samples, and in the general manipulation of the torch and filler rods may be observed. All welders hired regardless of their previous experience or whether or not they were qualified, are required to pass a qualification test after a period of about two weeks. During this intermediate period unqualified welders are permitted to do tacking and welding on nonstructural parts under close supervision. Such welders who do not subsequently qualify but give indications of the ability to do so with further practice are retained on tacking and nonstructural work for an additional short period of time. Then they are re-examined at the discretion of the welding supervisor. Welders who fail to qualify on the second test are normally released for other types of work or retained for tacking jobs, provided openings are available for this class of work.

### *Qualifying Welders*

Welding qualification tests fall into only two types: (a) Oxyacetylene gas welders and (b) Oxyhydrogen gas welders. These types are further broken down into the groups of material to be welded: group 1, plain carbon steel and alloy steel; group 2, stainless steel and corrosion-resistant steel; group 3, nickel alloys; group 4, aluminum alloys; and group 5, magnesium alloys.

Welders who have qualified for one or more groups may not weld alloys of an additional group without first passing the full qualification procedure for that additional group. Welders who have qualified by welding a certain alloy are permitted to weld other alloys within the same group without taking another examination. Those welders holding certificates for welding groups 2, 3, 4, and 5, if regularly employed, need not be re-examined for qualification.

Qualified welders resuming work at the same plant after a period of unemployment of six months or more are re-examined in a manner similar to that for unqualified welders. Qualified welders are also transferred from one plant to another, and vice versa, without requalification. Qualified welders resuming

Presented at the Materials Session, Tenth Annual Meeting, I.Ae.S., New York, January 29, 1942.

* Materials and Process Engineer.

# *New Data* on Spot Welding of Nickel, Monel *and* Inconel

***Result of a two year research program at the Welding Laboratory of the Rensselaer Polytechnic Institute***

**Definite information on the spot welding of Nickel, Monel* and Inconel* was presented last October at the Annual Meeting, A.W.S., in Philadelphia. Reprints of this paper, by Wendell F. Hess† and Albert Muller‡, are now available.**

**The results reported include data on:**

1. **Recommended welding conditions for producing sound spot welds in Nickel, Monel and Inconel sheet.**
2. **Strength of spot welds.**
3. **Recommended electrodes.**
4. **Control of energy input.**
5. **Limit of permissible distortion, and method of measuring it.**
6. **Load-distortion characteristic curve for single-spot lap-weld specimens.**
7. **A fast, efficient method for evaluating quality of spot welds made in shop.**

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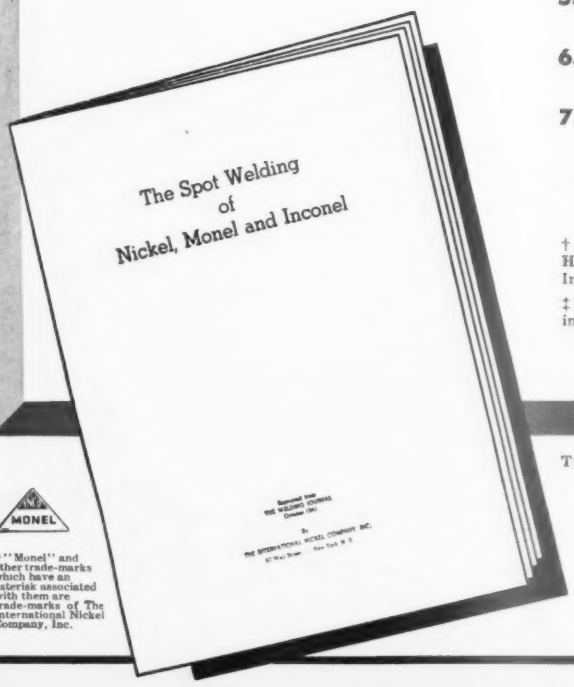
‡Research Fellow, Department of Metallurgical Engineering, Rensselaer Polytechnic Institute, Troy, N. Y.

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work at a plant after twelve months or more of continuous welding in similar grades of alloys but at other firms are to be re-examined in a manner similar to that for unqualified welders.

At the discretion of the welding supervisor, inspector, or torch welding engineer from the Materials Laboratory, checks on welders are made by selection of production, or other samples, in addition to those regularly specified.

In general, all qualification tests used in evaluating welding ability conform with current Army and Navy Specification requirements for the class and type required, except that these Specifications have been elaborated upon to include the evaluation of fusion and fillet size as will be explained later.

## Welding Tests

Fig. 1 shows a V-butt weld made with a single reinforcement. The reinforcement is machined off and the sample is cut into test specimens of the form and dimensions shown. Not less than three specimens are cut from the sample. A tensile test should be made on each specimen, and the average strength for the three samples should not be less than given in the table in Fig. 1. The strength of any individual specimen should not be less than 90 per cent of the average value given in the table.

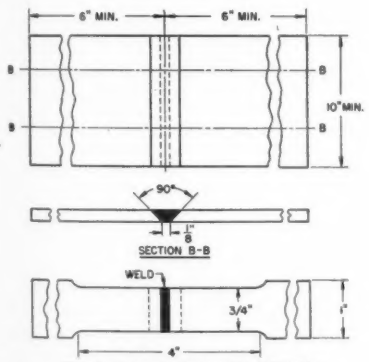


TABLE
TENSILE STRENGTH WELD METAL - LBS. PER SQ. IN.

| CARBON CONTENT OF FILLER ROD, % | CARBON STEEL BASE METAL UTS - PSI | ALLOY STEEL BASE METAL UTS - PSI |
|---|---|---|
| UP TO 0.06 INCL. | 45,000 | 55,000 |
| 0.07 TO 0.12 | 50,000 | 65,000 |
| OVER 0.12 | 55,000 * | 70,000 * |

* THESE VALUES SHALL BE USED FOR ALLOY STEEL FILLER ROD.

Fig. 1.

For the purpose of record—in addition to tensile strength—yield strength, elongation per cent in 2 in., location and other relevant remarks regarding the fracture, such as fusion and porosity, are noted.

The open butt weld shown in Fig. 2 should be made with the tubes in a horizontal position for one specimen and in a vertical position for a second specimen. One set consisting of a horizontal and vertical specimen should be welded on the bench and a similar set should be welded in an overhead position not lower than the welder's eyes. The overhead specimens should not be rotated. The joints are tested as tensile specimens with the reinforcement. The strength of the joint should not be less than 50,000 lbs. per sq.in. for plain carbon steel and 80,000 lbs. per sq.in. for alloy steel, calculated on the area of the base metal.

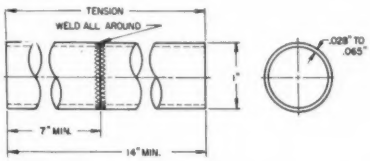


Fig. 2. Tubular butt weld, joint 2 (for Group 1 alloys only). (Horizontal and vertical for downhand and overhead.)

Bench (downhand) welded joints should be identified by A = horizontal and B = vertical. Overhead welded joints should be identified by C = horizontal and D = vertical.

In addition to the strength test, welded samples should be visually examined for appearance (undue unevenness or roughness), bead size, multiple bead, loose edges, undercutting, cracks, and burning, and the broken specimens should be examined for fusion and porosity (if the fracture occurs in the weld).

A vertical fillet weld is shown in Fig. 3. The joint should be made with the sheet standing on edge. Welding should be from the bottom up. The pieces are to be supported so that there is a clearance between the lower end of the seam and the jig. The joint should be tested in tension as indicated. A joint of this type should develop not less than 10,000 lbs. per linear in. in case the base metal is plain carbon steel and 15,000 lbs. per linear in. for alloy steel.

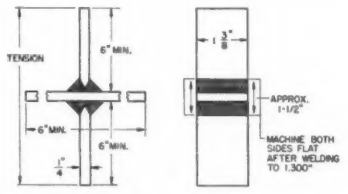


Fig. 3. Vertical fillet weld, joint 3 (for Group 1 alloys only). (Downhand.)

The strength test of welded samples should be supplemented by visual examination for appearance (undue unevenness or roughness), fillet size, multiple fillet, loose edges, undercutting, cracks, and burning. Broken specimens that fail in the weld should be examined for fusion and porosity and also for the determination of penetration of fusion into the base metal in the corner.

Fig. 4 illustrates a combination sheet and tube fillet weld. In addition to the normal visual examination, this joint shall be cut at sections A-A and the included center piece should be polished and etched with 50 per cent aqueous hydrochloric acid at a temperature of approximately 180°F. (82°C.) (or saturated ammonium persulfate), for a sufficient length of time to bring out the boundaries between the weld metal and the base metal. A visual examination of the section should be made in order to determine the presence of blowholes or porosity in the weld metal, fusion, cracks, burning and the penetration of the weld metal into the base metal. A penetration between 25 and 40 per cent below the surface of the base metal is desired in the case of material 1/8 in. or thicker. The per cent penetration may be greater than this for thinner materials.

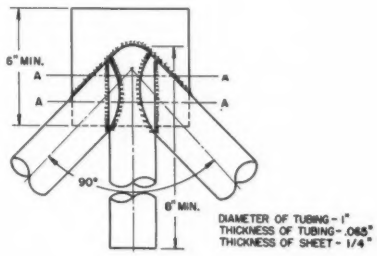


Fig. 4. Combination sheet and tube fillet weld, joint 4 (for Group 1 alloys only). Three tube joint (downhand).

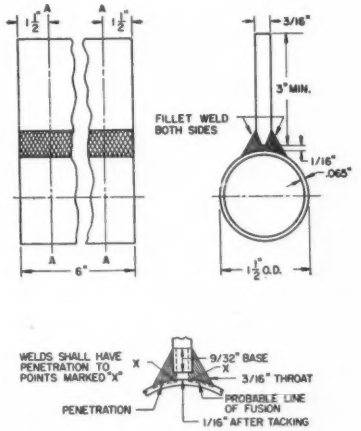


Fig. 5. Horizontal T-fillet weld, heavy plate to light tubing, alternate joint 4 (for Group 1 alloys only). (Downhand.)

Welders holding a certificate for welding group 1 alloys, if regularly employed, are re-examined for qualification every six months by welding joint 4 or equivalent.

The horizontal T-fillet weld (Fig. 5) should be made in a horizontal position by either the forward or backward method of welding. The tube and plate sizes indicated should be strictly adhered to. After welding, the joint is

visually examined as previously indicated. In addition, the test specimen should be cut in two planes at A-A and the exposed surfaces of the end sections of the included centerpiece shall be prepared and macroetched. The etched surfaces in the weld zones should be inspected for the following factors: (1) conformity of dimensions of welds with those given; (2) welds shall have full penetration to points marked X; (3) welds shall be uniformly and completely fused to the base metal at all points of contact; (4) weld metal shall be sound and free from gas pockets, fissures, oxide plates, laps or similar defects.

Fig. 6 illustrates test pieces for aluminum and aluminum alloy and magnesium welding. Two pieces as indicated should be flange welded. The gauges of the pieces should be in the ratio of approximately 1 to 2 and should include representative light gauges in the range used in current production work.

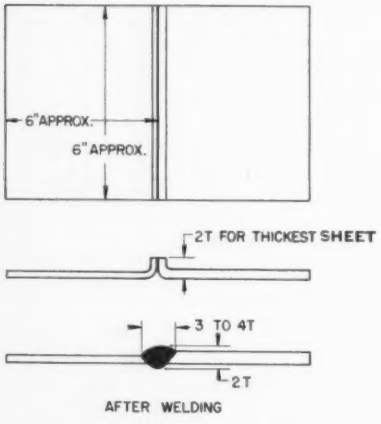


FIG. 6. Flange weld, joint 5 (for Groups 4 and 5 alloys). (Downhand.)

The flange-welded sample for group 4 is cut into one or more strips approximately 1 in. in width and is required to withstand bending 180 deg. over a diameter equal to one sheet thickness of the heavier of the two sheets without cracking. The underside of the bead shall be on the outside of the bend. The line of bend shall be on, and parallel to, the weld.

Flange-welded samples for group 5 (magnesium) are not required to withstand the bend test. In addition to the bend test, flange-welded samples are also visually examined.

The test shown in Fig. 7 consists of the manufacture of a butt-welded joint in sheets of the chemical composition to be used in production work of equal thickness and should represent approximately the thickest and thinnest sheets to be welded in production. For group 4, aluminum alloy, and group 5, magnesium alloy, joint 5 may be substituted for the thinnest butt sample. The joints should be approximately 6 in. long. The characteristics of the welds should be determined by visual examination and bend tests. The weld metal should be of uniform thickness, reasonably smooth surface and free from inclusions and irregularities, such as loose edges, undercutting, cracks, and burning, which indicate lack of sufficient experience or skill on the part of the welder. In case of sheets over $^1/_8$ in. in thickness the metal may be laid on both sides of the joint. In the case of sheets on the order of $^1/_{16}$ in. in thickness, a smooth well-rounded bead should be formed on both sides of the joint. The underside of the joint should be similar in appearance to the top.

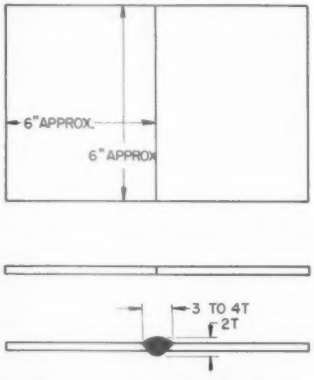


FIG. 7. Butt weld, joint 6 (for Groups 2, 3, 4, and 5 alloys). (Downhand.)

## BEND TESTS—ALLOYS IN GROUPS 2, 3, AND 4

The butt-welded joints described are cut into one or more specimens approximately 1 in. in width. The specimen is then bent 180 deg. over one sheet thickness so that the outside of the bend will lie in the plane of the weld. The outside of the bend should be on the side on which the weld is laid for joints welded on only one side. The joint shall not crack or show indications of lack of bond between the weld metal and the base metal. The excess metal on either side of the sheet should be ground smooth with the base metal before making the bend.

For Navy tests group 2 and group 3 qualifications will permit a bend over six sheet thicknesses, otherwise testing as above, and group 4 qualifications will permit a bend over four sheet thicknesses. Bend tests are not required for group 5 alloys.

The horizontal T-fillet weld joint shown in Fig. 8 should be similar to alternate joint 4, except that a $^1/_{16}$-in. sheet may be substituted for tubing of $^1/_{16}$-in. wall, called for by alternate joint 4. The specimen should be examined in a manner similar to that for alternate joint 4.

Macroetching for alloys in groups 2 and 3 may be either with 50 per cent aqueous hydrochloric acid or saturated ammonium persulfate; for group 4 alloys macroetching should be accomplished with a 20 per cent solution of sodium hydroxide, followed by a wash in dilute nitric acid and a water rinse; for group 5 alloys macroetching should be done with dilute nitric or sulfuric acid, followed by a water rinse.

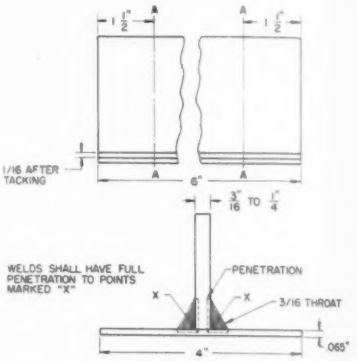


FIG. 8. Horizontal T-fillet weld, heavy plate to light sheet, joint 7 (for Groups 2, 3, 4, and 5 alloys). (Downhand.)

## PRODUCTION JOINTS

In addition to the test welds just described, production parts are selected periodically and examined. These will of necessity, be of miscellaneous nature. Joints for group 1 should be tested in a manner similar to that for joint 4 by sectioning, etching and microexamination. Joints for groups 2, 3, 4, and 5 should be tested in a manner similar to that for joint 7. Any faulty results discovered in this manner by the welding engineer are called to the attention of the welder and supervisor for immediate correction and retest. Production test samples are held for a period of six months for reference check. Records of production tests are not distributed unless specifically requested. Production checking, as outlined herein, should form an important basis for the assignment of welders to jobs of varying degrees of difficulty and for promotion of welders to more difficult jobs.

## TESTING OF WELD JOINTS FOR QUALIFICATION

All the described tests are performed by a representative of the Materials Laboratory under the direction of the welding engineer, witnessed by an inspector representing the procuring agency.

Tested samples may be returned to the welder when desirable, as an aid in improving his knowledge and technique. Otherwise, they are held for a minimum of thirty days before discarding.

### Method of Grading

After testing, grading of the weld joints should be as follows: The passing grade for any weld specimen should be 70; 70 to 79—good; 80 to 89—very good; 90 to 100—excellent.

When any specimen of any sample fails, the entire examination should be considered a failure. Grading of welds is based on physical properties, exterior appearance, and interior appearance as indicated by fractures and macro-examinations.

Individual grading is applied to each of the following points: tensile strength, bend, appearance and warpage, bead or fillet size, multiple bead or fillet, loose edges, undercutting, fusion, penetration, porosity, cracks, and burning or overheating.

Since in the evaluation of most of the factors of a weld a division of 30 points, between 100 and 70, would be too arbitrary, the divisions are confined to six demerits, each representing five points on the scale. For example, if three demerits are awarded for Porosity, the grade would be 85, etc. A maximum of six demerits is allowable.

It is within the realm of possibility that a weld joint would be so deficient in any single property as to cause rejection. This should be noted by awarding seven demerits for the property. Welds receiving six demerits in three or more properties or five or six demerits in five or more properties are rejected. For remaining welds the final grade shall be determined by averaging the demerits, multiplying by 5, and subtracting from 100.

#### *Grading for Tensile Strength*

Weld samples meeting the minimum specified requirements for tensile strength receive no demerits; those failing receive seven. There are no other demerit awards for tensile strength.

#### *Grading for Bend*

Weld samples meeting the minimum specified requirements for bend tests receive no demerits, and those failing receive seven. There are no other demerit awards for bend requirements.

#### *Grading for Appearance*

Welds with a commercially satisfactory appearance receive no demerits for appearance. Welds satisfactory in all respects except a moderate amount of unevenness and roughness receive one or two demerits. Welds that are deficient because of fillet size undercutting, burning, etc., receive demerits for appearance, as well as for those particular properties.

#### *Grading for Warpage*

This property, except under rare conditions, will not occur to a sufficient degree to be considered on the small weld sample joints as specified. It is considered and graded when encountered on production samples by including it with appearance. Welds with sufficient warpage to render the part unsatisfactory for use receive seven demerits. Less warpage is graded proportionally.

#### *Grading for Bead or Fillet Size*

Joints 1, 2, 5, and 6, which consist of butt welds and flange welds, should have bead dimensions approximately three to four times the sheet thickness (Fig. 9).

Fig. 9.

#### *Production Joints*

If consisting of edge welds, production joints should have dimensions across a width of two to three times the sheet thickness and a thickness of 0.6 to $1^1/_4$ times the sheet thickness (Fig. 10). Joints 3, 4, 4A, and 7, which consist of fillet welds, should have dimensions approximately as indicated in the table in Fig. 11.

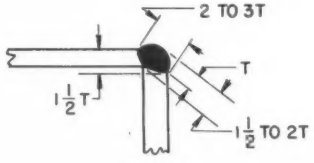


Fig. 10.

| FILLET WELDS | | | | LAP WELDS | |
|---|---|---|---|---|---|
| SHEET THICKNESS | MAX. LEG. | MAX. LEG FOR ACUTE ANLE WELD | MIN. THROAT | MAX. LEG | MINIMUM FILLET THICK. MEASURED 1.5 T FROM EDGE OF SHEET |
| .031 | .13 | .16 | .06 | .22 | .03 |
| .038 | .15 | .19 | .07 | .25 | .04 |
| .050 | .19 | .24 | .09 | .30 | .05 |
| .063 | .21 | .26 | .10 | .33 | .06 |
| .078 | .25 | .31 | .12 | .35 | .08 |
| .093 | .28 | .35 | .13 | .37 | .09 |
| .125 | .34 | .42 | .16 | .47 | .13 |
| .180 | .40 | .50 | .21 | .62 | .19 |
| .250 | .57 | .71 | .27 | .75 | .25 |

Fig. 11. Table of standard fillet proportions (including those for lap welds).

It is desirable to standardize bead and fillet sizes because, if too large, they may result in excessive sheet warpage, interference with mating of parts, overheated base metal, and unnecessary weight and labor expenditure. If they were too small, lowered strength would result. Welds with beads or fillets that closely conform to the above tolerances should receive no demerits. Welds with beads or fillets sufficiently off size to warrant rejection receive seven demerits, and welds of intervening nature are graded proportionally.

#### *Grading for Multiple Bead or Fillet*

Welds with multiple bead or fillet indicate that it was necessary for the welder to go over his work to improve or to complete his first attempt. For small welding work it is desirable to complete the weld with a single bead or fillet. Joint 3 welds or similar types require certain puddling back and forth, first to get full penetration and, finally, to fill up to size.

Small welds with multiple bead or fillet should receive two demerits when fusion is satisfactory, and all welds receive demerits to a total of seven when bonding between beads or fillets is defective.

#### *Grading for Loose Edges*

It is possible for welds to possess loose edges and yet be satisfactory in other respects. This is shown in Fig. 12. A loose edge may also impair weld strength when associated with reduced fusion as indicated in Fig. 13.

Fig. 12.

Fig. 13.

Welds with loose edges which do not impair weld strength receive two demerits. When the loose edges indicate reduced fusion, welds receive additional demerits, and when this reduction of fusion is sufficient to cause a 30 per cent reduction of weld strength in either leg of a fillet or bead, the weld receives seven demerits.

#### *Grading for Undercutting*

Welds with undercutting sufficient to reduce the weld strength by an estimated 30 per cent in either leg of any fillet or bead receive seven demerits. Welds with smaller degrees of undercutting are to be graded proportionally.

#### *Grading for Fusion*

Fusion is illustrated diagrammatically in Fig. 14. Welds with lack of fusion sufficient to reduce the weld strength by an estimated 30 per cent in either leg of any fillet or bead receive seven demerits. Welds with smaller

# Dear Pop:

Even an old Rainbow Divisioner like you would pop your eyes at the army we're putting together this time. Let me tell you, they're doing everything to make up just about the best bunch of fighting galoots you ever saw.

And that goes for what they do for us off duty, too! Take this new clubhouse we got just outside of camp. It's got radios, dance floors, nice soft chairs and everything. And, Pop, you can get something to eat that won't cost you a month's pay!

Now, the army isn't running this. The USO is. And most of the other camps got USO clubs too, because you and a lot of other folks dug down and gave the money to the USO last year.

But, Pop, you know what's happened since then. Guys've been streaming into uniform. Last year there was less than 2 million of us. This year there'll be 4 million. And the USO needs a lot more dough to serve that many men—around 32,000,000 bucks I hear.

Now, Pop, I know you upped with what you could last time. But it would sure be swell if you could dig into the old sock again. Maybe you could get some of the other folks in the neighborhood steamed up, too.

It will mean an awful lot to the fellows in camp all over the country. Sort of show 'em the home-folks are backing them up. And, Pop, an old soldier like you knows that's a mighty nice feeling for a fellow to have. See what you can do, huh, Pop?

*Bill*

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degrees of lack of fusion are to be graded proportionally. When a section under examination has two or more weld fillets or beads, the legs with the lower fusion for each fillet or bead are averaged.

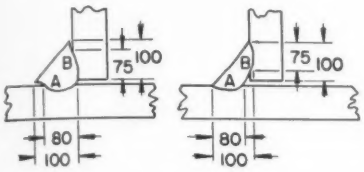


FIG. 14. Legs A have 80 per cent fusion; legs B have 75 per cent fusion.

### *Grading for Penetration*

In a sense, penetration and fusion are similar, although penetration refers to that particular fusion at the depth of the fillet or bead. Lack of fusion or penetration to the depth of a fillet or bead is especially undesirable because of the likelihood of developing stress concentration at that point. Welds without penetration or fusion to the depth of a fillet or bead receive five demerits.

### *Grading for Porosity*

Porosity consisting of minute blowholes ($^1/_{32}$-in. diameter or smaller), if approximately of spherical shape and if fairly uniformly distributed and below the exterior surface, may have little effect on physical properties. Welds with porosity of this type should receive no demerits. Welds with porosity sufficient to cause rejection receive seven demerits and those intervening are graded proportionally.

### *Grading for Cracks*

Since cracks may result in stress concentration and since they constitute definite indication of faulty materials or technique, welds with cracks of more than superficial nature (confined to within a few thousandths of an inch of the exterior) receive a minimum of five demerits. Welds with cracks sufficient to cause rejection receive seven demerits.

### *Grading for Burning*

Burned metal is embrittled from oxides that envelop the metal grains. This is undesirable since it produces a condition akin to a combination of porosity and cracks. Welds with burned metal receive a minimum of five demerits. Welds with sufficient burning to cause rejection receive seven demerits.

## CERTIFICATE OF WELDER'S QUALIFICATION TEST

Welders are qualified by the use of certificates. This certificate is universal in that it is applicable to all current Army-Navy weld qualification specifications and complete in that no additional forms are required for testing and recording. Data in addition to qualification tests are obtained by the torch welding engineer by interviewing the welder and from other sources. The remainder of the certificate is filled in as the tests are progressively completed, graded by the torch welding engineer of the Materials Laboratory, witnessed by an inspector for the procuring agency and signed for both.

Subcontractors applying for welders' qualification certificates forward certificates filled in and attached to an affidavit accompanying test samples previously described. These certificates should then be completed at the procuring agency as indicated. All original certificates are filed by the Materials Laboratory. Typewritten copies are made up at the Materials Laboratory, with a copy held on file, and are delivered to the inspectors for the procuring agency, subcontractors, and others when desirable.

Grading is recorded on the demerits table on the certificate, and in each block of the table is entered a figure from 0 to 7 or the block is crossed out.

Pertinent remarks should be included under "Recommendations," and when a welder has qualified, his overall grade should be recorded there—viz.: "Grade 88—Very Good," etc.

## ROUTINE PRODUCTION CHECKS

After qualification, additional checks of welders by the torch welding engineer proceed on the same certificate form.

## WELDERS' IDENTIFICATION

Upon taking an examination for qualification, welders are assigned two-letter $^1/_8$-in. metal stamps as follows: AA, AB, AC, . . . . AZ; BA, BB, BC, . . . . BZ; CA, . . . ., etc. These letters are permanently assigned upon qualification of the welder and are stamped on each production job completed for the purpose of identification. Subcontractor's welders are assigned a similar stamp consisting of one letter followed by a number, as follows: M1, M2, etc. Each vendor shall have an identifying letter established in coordination with the torch welding engineer.

Welders who have qualified under this specification receive a badge that must be worn in plain view while on welding duty. The badge also specifies the group of alloys for which the worker is qualified.

An alphabetical list of welders' identification is maintained by the torch welding engineer in the Materials Laboratory. Qualified welders are entered alongside their respective identification, together with the group of alloys for which they have qualified, the date on which they qualified and the date of production checks per year.

Copies of this list are forwarded to the inspector for the procuring agencies at the end of each year and the original is kept on file in the Materials Laboratory.

## REFERENCES

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[8] Navy Dept., Bureau of Aeronautics, Specification SR14c, *Qualification Tests for Aircraft Welders (Steel Welding);* Navy Dept., Washington, D.C., November 1, 1940.

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[10] Navy Dept., Bureau of Aeronautics, Specification PW-2a, *Process for Gas Welding Aluminum and Aluminum Alloys (Aircraft Use);* Navy Dept., Washington, D.C., October 14, 1937.

[11] Navy Dept., Bureau of Aeronautics, Specification PW-5b, *Process for Gas Welding Magnesium Base Alloys;* Navy Dept., Washington, D.C., December 18, 1940.

[12] Curtiss-Wright Corp., Airplane Division, Buffalo Plants, *Engineering Report 5066, Welding Procedure Control Outline;* Revision D, December 14, 1938.

[13] Curtiss-Wright Corp., Airplane Division, Specification MLP-1, *Organization of Materials Laboratory;* November 30, 1941.

# 8 for 1

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# Flying the Figure Eight

ARTHUR S. OTIS*

*World Book Company*

### Introduction

A candidate for the rating of private pilot is required to execute a number of maneuvers, one of which is flying a figure eight around pylons. There are two methods of doing this: One is to fly each loop with the lateral axis of the airplane constantly pointing directly toward the pylon except when passing from one loop to the other. A figure eight flown in this manner has been called an "on-pylon eight." The second method is to fly each loop with the airplane held a constant distance from the pylon except when passing from one loop to the other. A figure eight flown in this manner has been called an "eight around pylons," as distinguished from the on-pylon eight.

It would seem that the second is not a good name, since either eight is an eight around pylons. It is suggested that the eight flown according to the second method be called a "circular eight around pylons" or merely a "circular eight" when it is understood to be around pylons.

### The On-Pylon Eight

Both types of eight are required to be flown at constant altitude. When there is no wind the airplane does not drift during the eight and, if the loops of the eight are flown so that the airplane points toward the pylon, it will describe an arc with the pylon as center—that is, it will remain a constant distance from the pylon except while passing from one loop to the other. Hence, when there is no wind, an on-pylon eight is also a circular eight, as shown in Fig. 1. However, the opposite is not necessarily true. That is, a circular eight is not necessarily an on-pylon eight even with no wind, as will be explained.

A circular eight can be flown at any altitude—that is, it is possible for a pilot to fly a loop around a pylon at any altitude and keep the same distance from it during the loop. This is not true, however, of an on-pylon eight.

All pilots know that it takes a certain definite amount of banking to enable a plane of given air speed to fly a circle of given radius. It requires a 34 deg. bank, for example, for an airplane with an air speed of 100 m.p.h. to fly a circle of 1,000 ft. radius. (The 34-deg. bank is required to give it just the right amount of centripetal force to make a turn of that radius.)

An airplane that is 1,000 ft. distant from a pylon flying at a 34-deg. bank can have its lateral axis pointing to the pylon only when it is a definite distance above the pylon as shown in Fig. 2.

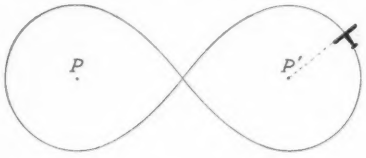


Fig. 1.

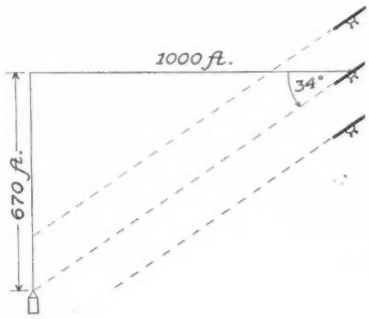


Fig. 2.

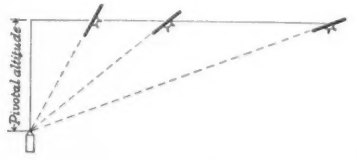


Fig. 3.

### Pivotal Altitude

The definite altitude necessary for an on-pylon turn at a given air speed is called the "pivotal altitude" for that air speed. In Fig. 2 the pivotal altitude is 670 ft. This is the pivotal altitude for an airplane with an air speed of 100 m.p.h.

The pivotal altitudes for some other air speeds are as follows:

| Air Speed | Pivotal Altitude |
|---|---|
| 80 m.p.h. | 429 ft. |
| 90 m.p.h. | 543 ft. |
| 100 m.p.h. | 670 ft. |
| 110 m.p.h. | 811 ft. |
| 120 m.p.h. | 965 ft. |

The pivotal altitude for any air speed can be found by the formula

$$\text{pivotal altitude} = 0.067\ (\text{air speed})^2$$

where air speed is in m.p.h.

It so happens that the necessary centripetal force needed for a turn of a given radius is so related to the angle of bank that an airplane can fly at its pivotal altitude at any degree of bank and still have its lateral axis pointing directly toward the pylon during the turn, as shown in Fig. 3. Regardless of the radius of the turn and regardless of the angle of bank an airplane of given air speed can fly an on-pylon turn at only one altitude—the pivotal altitude for that air speed.

There is a rather prevalent belief among pilots that in flying an on-pylon turn one must fly higher for a steep bank than for a shallow one, but this is not true; the altitude is the same for all angles of bank for an on-pylon turn at a given air speed. The pivotal altitude for a given air speed can be found by the formula previously given, regardless of the angle of bank.

### Effect of Altitude

Obviously, if a candidate wishes to fly a good on-pylon eight he must fly the eight at an altitude somewhere near the pivotal altitude. Of course a pilot cannot expect to be able to fly at exactly 543 ft.—the pivotal altitude for 90 m.p.h.—but he can get between 500 and 600 ft. and that may be close enough. Suppose he tries to fly the on-pylon eight at 800 ft. If the airplane is properly banked for whatever radius is used, the wing will point considerably above the pylon. Then, if the pilot tries to point the wing toward the pylon, the airplane will be banked too much. In order to hold a too-steep bank and maintain altitude the pilot must use cross controls and sideslip the airplane, holding the nose high. Obviously, this will not be permissible.

If the pilot is trying to fly at too steep a bank and does not sideslip with nose high to hold the bank and the altitude, the airplane will lose altitude by sideslipping on its own account. This will count against the candidate for not maintaining altitude, as well as for allowing the sideslip.

If the candidate sets out to fly the eight at the proper altitude, half the

* Mathematical Consultant.

battle will have been won at the start. The second step toward success is to know what sort of path must be made and not try a path that cannot be made.

### Effect of Wind

If the eight is a circular eight, the loops are arcs of circles with the pylons as centers. If the eight is an on-pylon eight, if no wind is blowing, and if the eight is flown at the pivotal altitude, its path also will have loops that are arcs of circles as shown in Fig. 1. If the eight is an on-pylon eight and the wind is blowing, the airplane cannot fly a path with loops that are arcs of circles for the reasons that follow.

It is customary to choose pylons for a figure eight so that the line joining them is perpendicular to the direction of the wind, as shown in Fig. 4. Also, it is customary to enter the eight in such a way that when flying at the end of a loop the airplane will be heading up-wind and, hence, when crossing the line between the pylons, will be flying partially down-wind.

The important thing to understand regarding the path of an on-pylon turn is that at all times when the airplane is on the down-wind side of the axis of the eight and the lateral axis of the plane is pointing toward one of the pylons the plane is drifting away from the pylon. At all times that the plane is on the up-wind side of the axis of the eight with its lateral axis pointing toward the pylon the plane is drifting nearer to the pylon.

The loops of the eight are not arcs of circles as when there is no wind. In fact, the loops are elliptical, as shown in Fig. 4. In this illustration the eight is symmetric with reference to the axis of the eight—the line joining the pylons. If any line (AB) perpendicular to the axis of the eight is drawn, it will cut the path just as far from this axis on the up-wind side as on the down-wind side.

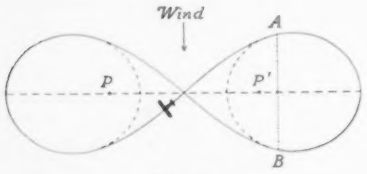


Fig. 4.

As soon as an airplane has been banked on the down-wind side of a loop so that its axis points toward a pylon, it begins to drift away from the pylon. It is fartherest from the pylon at the end of the loop. Then, after crossing the axis of the eight, it drifts nearer and nearer to the pylon so long as its axis points toward the pylon.

To understand the nature of this drifting away from and nearer to the pylon, the motion of the airplane, as caused by the combination of propeller thrust and wind motion, must be analyzed.

Let P in Fig. 5 represent the position of a pylon and A the position of the airplane at a given time. Let the wind be blowing as shown.

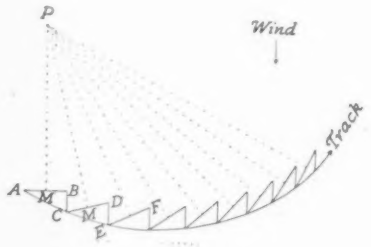


Fig. 5.

Assume that the airplane flies a short distance AB with reference to the air, the perpendicular to AB at its midpoint M passing through P. It is known that during this short flight the wind has blown the aircraft some distance BC, so that it has actually traversed a path from A to C.

If it is assumed that the airplane is to fly a similar short distance CD with reference to the air, again with a perpendicular to CD at its midpoint passing through P, it will be blown a distance DE equal to BC, so that a path from C to E is actually flown.

If this process is continued, as shown in Fig. 5, a figure like Fig. 6 is obtained, showing that a complete path around the pylon is an ellipse.

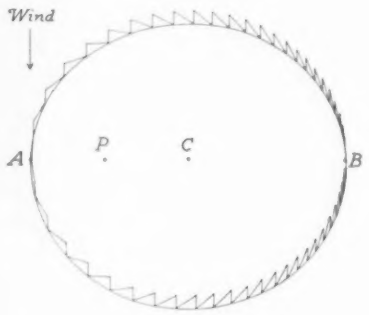


Fig. 6.

### The On-Pylon Turn in a Wind

A mathematical derivation of the path of an on-pylon turn in a wind at uniform velocity shows that the path is an ellipse with the pylon at one of the foci and of such shape that the ratio of the distance between foci to the major axis of the ellipse equals the ratio of the wind velocity to the air speed. If the wind is blowing half as fast as the air speed, then the distance PC of the pylon from the center of the ellipse is half the distance AC—the distance of the airplane from the center when nearest the pylon. In this case, when at B, the airplane flying directly up-wind would be just three times as far from the pylon as when at A flying directly down-wind.

When flying an on-pylon eight in a wind the pilot must remember that the path in a loop is a portion of an ellipse and not the arc of a circle and, hence, he must not try to keep equidistant from the pylon while flying the loop. If he does, he will find himself using cross controls. It should be understood that the stronger the wind the more elongated the ellipse and that the pilot is always fartherest from the pylon at the moment he is flying directly up-wind.

If the wind velocity is slight (say, not over one-tenth or two-tenths of the air speed), the ellipse is only slightly different from a circle and might easily be mistaken for a circle, although the center of the curve would be appreciably off the pylon.

If the pilot flies the on-pylon eight at the right altitude and allows the airplane to drift away from the pylon and then back toward it as necessary and if he does not attempt to prevent this by cross controls, he will find the on-pylon turns fairly easy. He may then devote his attention to learning when to start banking so that the wing points to the pylon just as a point opposite to it is reached, and when to start leveling the airplane preparatory to entering the other loop.

The amount of banking changes, of course, as the airplane drifts farther from or nearer to the pylon during the loop, but the altitude remains the same regardless of these changes. Since the pivotal altitude is correct for any degree of bank for a given air speed, it is correct for a change from one bank to another.

It is understood that the airplane is banked least when fartherest from the pylon, which is when flying directly up-wind, and is banked most at the points where the wing is first pointed toward the pylon in entering the loop and where the wing is last pointing to the pylon before being leveled for the crossing to the other loop.

### Power Changes

A pilot is required to fly an on-pylon eight at approximately constant altitude. Consequently, it must be flown at approximately constant speed. Theoretically, to keep the altitude constant the speed must be constant, because there is only one air speed for a given pivotal altitude—the greater the air speed the greater the pivotal altitude. Also, since it requires more power to fly with a steep bank than with a shallow bank at the same air speed, it follows that to maintain the same air speed more power must be used for the steeply banked portions of the eight than for the less banked portions.

Since it is theoretically impossible to fly an on-pylon eight with precision at a constant altitude except at constant air speed, it is assumed throughout this article that the air speed is kept constant.

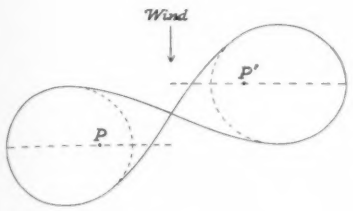


FIG. 7.

It has been explained that the on-pylon eight is supposed to be flown around pylons so chosen that the line joining them is perpendicular to the direction of the wind. If this is not feasible and the line joining the pylons is not perpendicular to the direction of wind, the path of the on-pylon eight will be as shown in Fig. 7. In this case the eight is not symmetric, since the long axis of the ellipse forming the basis of each loop is perpendicular to the direction of the wind. This lack of symmetry makes the eight harder to fly with precision, and no doubt this is the reason it is specified that the pylons should be chosen so that the line joining them is perpendicular to the direction of wind.

### THE AIR PATH

It is of value to the pilot to understand the nature of the air path he is flying while executing a figure eight. Consider for a moment the air path necessary to fly a circle around a pylon with the wind blowing.

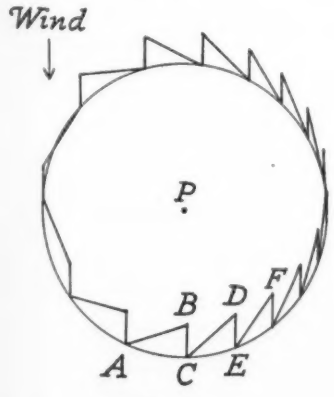


FIG. 8.

Fig. 8 shows the circular path an airplane might make over the ground while flying around a pylon. If the wind is blowing in the direction indicated by the arrow, it is known that in order to fly from A to C on the circle the pilot, when at A, must head in a direction AB so that as the air path AB is flown he will drift a distance BC and, hence, arrive at C. Similarly, when at C, he must have a heading in the direction CD so that as the air path CD is flown he will drift the distance DE and arrive at E, etc.

If the air paths AB, CD, EF, etc., are joined, a curve as shown in Fig. 9 is obtained. It turns out to be a series of loops.

It is seen that the air path is straightest at G where the flight is directly up-wind. It is most curved at H where the flight is directly down-wind. When at G (Fig. 10), the airplane has the least

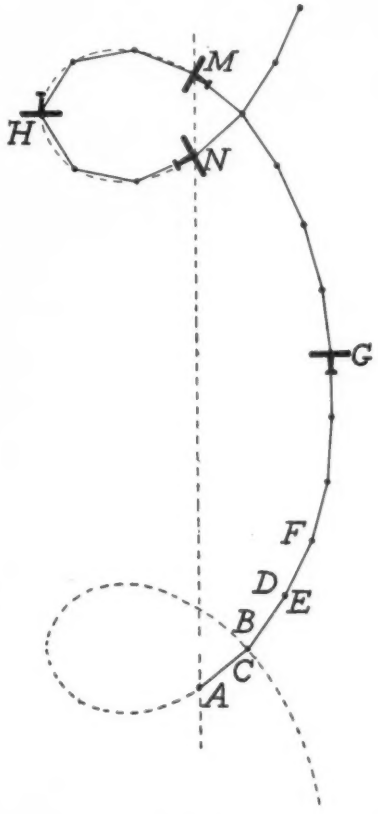


FIG. 9.

bank, and at H has the greatest bank, as shown in the lower drawing.

When the airplane is at G, if it is flying at its pivotal altitude, its lateral axis is pointing at that instant to a spot on the ground a distance from the airplane equal to the radius of curvature of the path at G in Fig. 9. This is a greater distance than from the airplane to the pylon. Similarly, if it is at the pivotal altitude when at H, its lateral axis is pointing at that instant to a spot on the ground a distance from the airplane equal to the radius of curvature of the path at H in Fig. 9. This is a lesser distance than from the airplane to the pylon.

Between G and H the bank is gradually and continually increasing and between H and G it is gradually and continually decreasing.

### WING ATTITUDE

When the airplane is at M directly up-wind from the pylon in Fig. 10, it has a heading the same as at M in Fig. 9 (tangent to the air path in Fig. 9), and when at N it has a heading the same as at N in Fig. 9. The lateral axis, therefore, does not point toward the pylon when the airplane is at M or N. At no time does the lateral axis point even in the horizontal direction of the pylon during the flying of a circle around the pylon in a wind except when flying directly up-wind (at G) or down-wind (at H). As previously shown, when at G the bank is so slight that the lateral axis points over and beyond the pylon, and when at H the bank is so

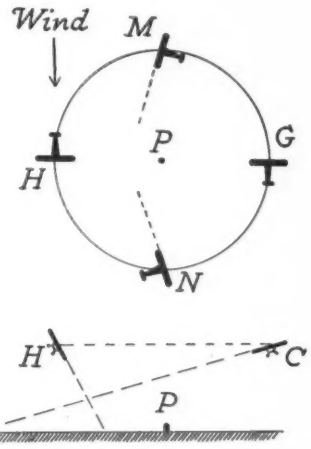


FIG. 10.

steep that the lateral axis points to a spot nearer than the pylon.

It can be seen from this discussion that in flying a circle around a pylon in a wind at a constant altitude and constant air speed, the lateral axis never points directly toward the pylon. When flying up-wind, the bank is too slight and the lateral axis points above the pylon. When flying cross-wind on the up-wind side of the pylon, the wing points ahead of the pylon. When flying down-wind, the wing points to a spot nearer than the pylon. And when flying cross-wind on the down-wind side of the pylon, the wing points behind the pylon.

When a pilot is flying a circular eight, his airplane, when on a loop, is subject to the conditions discussed, and therefore he should understand that in flying a true circular eight the wing can be pointed only approximately in the direction of the pylon.

The stronger the wind, the farther

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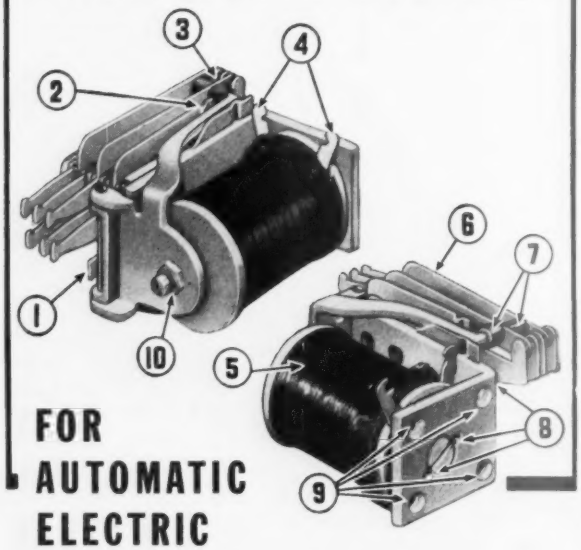


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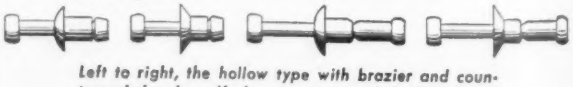

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from the pylon the wings will point in a true circular eight. If the pilot wishes to fly a true circular eight in a stiff wind, therefore, he must give up all effort to point the wing toward the pylon and give his attention to keeping the distance from the pylon constant. If it is kept in mind how the wings must point—now beyond the pylon, then ahead of it, then nearer than the pylon, then behind it—this may be a help.

If it is felt by the pilot that a circular eight has been flown with the wing constantly pointing to the pylon on the loops, it is probable that the wind was slight and the path was therefore slightly elliptic but not recognized as such.

The statements made here may be tested by trial flights on days when there is a good wind by choosing a pylon and flying around it several times. Keep the wing pointing directly at the pylon all the time. Take careful note of the point on the ground flown over directly down-wind (A—Fig. 6) and the point on the ground flown over directly up-wind (B—Fig. 6). Then fly around the pylon in the other direction, again keeping the wing always pointing toward the pylon, and try to fly over the same points (A and B). It will be absolutely impossible to fly over these same points.

## Conclusion

The purpose of this article is (1) to help the pilot fly an on-pylon eight in a wind with greater precision, by knowing (a) how to choose the right altitude, (b) how to maintain constant speed, (c) the air path of the airplane if the eight is properly flown, and (d) why not to try to keep the same distance from the pylon on the loops; and (2) to help him fly a circular eight in a wind with greater precision, by knowing (a) how the bank must change, (b) how the heading must change, and (c) why not to try to point the wing toward the pylon.

## Appendix

Appended herewith is the mathematical derivation of the nature of the path of the airplane flying an on-pylon turn. The equation of the path is obtained by integration and is found to be the equation of an ellipse with the pylon at a focus.

In Fig. 11, $P$ represents the pylon and $A$ the position of the airplane at some point on the on-pylon turn.

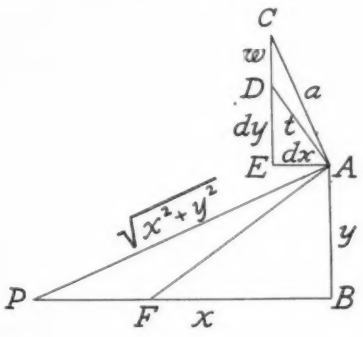


Fig. 11.

Line $a$, drawn perpendicular to $PA$, represents the air speed vector for a brief moment; $w$ represents the wind vector for that moment; and $t$ represents the track of the airplane for that same moment.

The derivatives $dx$ and $dy$ are the horizontal and vertical components of vector $t$, as shown in the figure.

Triangle $APB$ is similar to triangle $ACE$. Line $AF$ is drawn perpendicular to $AD$; hence the triangle $AFB$ is similar to the triangle $ADE$.

$$dy/dx = FB/AB \qquad (1)$$

but

$$\frac{PF}{PA} = \frac{w}{a} \text{ and } PA = \sqrt{x^2 + y^2} \qquad (2)$$

therefore

$$PF = (w/a)\sqrt{x^2 + y^2} \qquad (3)$$

and

$$FB = x - (w/a)\sqrt{x^2 + y^2} \qquad (4)$$

Let $r$ represent $w/a$, then

$$FB = x - r\sqrt{x^2 + y^2} \qquad (5)$$

and

$$\frac{dy}{dx} = \frac{x - r\sqrt{x^2 + y^2}}{-y} \qquad (6)$$

by integration

$$\sqrt{x^2 + y^2} = rx + k \qquad (7)$$

and, solving

$$x^2 - \frac{2rk}{1 - r^2}x + \frac{y^2}{1 - r^2} = \frac{k^2}{1 - r^2} \qquad (8)$$

Let $k$, the constant of integration $= 1 - r^2$; then

$$x^2 - 2rx + \frac{y^2}{1 - r^2} = \frac{(1 - r^2)^2}{1 - r^2} = 1 - r^2 \qquad (9)$$

Translate horizontally by letting $x = x_1 + r$; then by substituting and solving, Eq. (9) reduces to

$$x_1^2 + (y^2/1 - r^2) = 1 \qquad (10)$$

or the equation of an ellipse whose semimajor axis is 1 and whose semiminor axis is $\sqrt{1 - r^2}$.

Let $d$ represent the distance from the center of the ellipse of Eq. (10) to the focus. The square of this distance equals the square of the semimajor axis minus the square of the semiminor axis; therefore, solving, $d^2 = r^2$ and $d = r$.

This shows that the distance $r$ by which the ellipse was translated was the distance $d$. In other words, Eq. (7) is the equation of an ellipse with its origin at a focus of the ellipse. Since the origin of $x$ and $y$ was the pylon, it is seen that the ellipse of an airplane traversing an on-pylon turn has its focus at the pylon.

It will be remembered that we let $r = w/a$. Hence, $r/1 = w/d$—that is, the ratio of the distance of the pylon from the center of the ellipse to the length of the semimajor axis equals the ratio of the wind velocity to the air speed of the plane.

It was assumed in Fig. 2 that the wind was perpendicular to the $X$ axis. Since the resulting equation is that of an ellipse with its major axis on the $X$ axis, it follows that the ellipse that constitutes the path of the airplane in an on-pylon turn has its major axis perpendicular to the direction of the wind.

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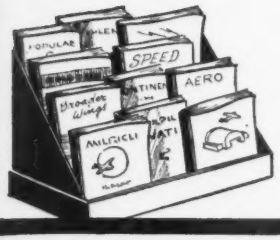


# Periodicals

*The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Engineering Review or the Institute of the Aeronautical Sciences.*

## Accessories

**France: Auxiliary Power Installations.** French methods for the use of electric and compressed air auxiliary power installations and their generation are described. *Interavia*, January 14, 1942, page 15.

**Substitutes Have Silver Linings.** W. C. Trautman. The Development Engineer of Bendix Aviation Ltd. describes their latest auxiliary hand pump for hydraulic systems. A feature of this hand pump is the elimination of many threaded joints to reduce the amount of tap, die and thread machine work. Its design allows for complete disassembly and reassembly with only a screw driver and a pair of pliers. With a reduced number of working parts, plastic materials replace metals in the piston head, piston rod bearing and both check valves. *Western Flying*, May, 1942, page 54, 1 illus.

## Aerodynamics

**Downwind Turns and Downwind Flight.** Observations on the velocity gradient and other factors bearing upon the flight characteristics of aircraft are discussed in a symposium on these effects. Illustrations and diagrams show the influence of obstructions and the movements of the air over the wings of an aircraft. The effects of the gradient on straight flights and turns, and the effects of "rollers" of air are also discussed. *Soaring*, March–April, 1942, pages 4, 8, 11, 9 illus.

## Air Cargo

**Engineering Problems Associated with Air Cargo Transportation.** A study of the engineering problems relating to air cargo transportation by R. D. Kelly and W. W. Davies of United Air Lines is contained in a report to the Society of Automotive Engineers. Among the conclusions reached is one that a cargo airplane should not differ basically in performance and general external appearance from a similarly sized passenger transport. Recommendations are made for the equipment that should be installed. Results of analyses of weight and payload are charted, as well as operating costs. Wing loading and other considerations are taken into account. *Automotive and Aviation Industries*, May 15, 1942, pages 34, 35, 4 illus.

**U.S.–Amazon Valley Cargo Line Advocated.** William M. Sheehan. The establishment of an air-cargo line running from the United States to various points in the Amazon Valley in Brazil is urged in this article which relates the experiences of the writer in traveling through Brazil. The types of airplanes suitable for the purpose are suggested. *American Aviation*, May 15, 1942, page 6, 2 illus.

## Air Power

**Design For Air Supremacy.** J. L. Atwood. The executive vice-president of North American Aviation describes the cooperation of the Army, the Navy and the aircraft industry. The system of free and open design

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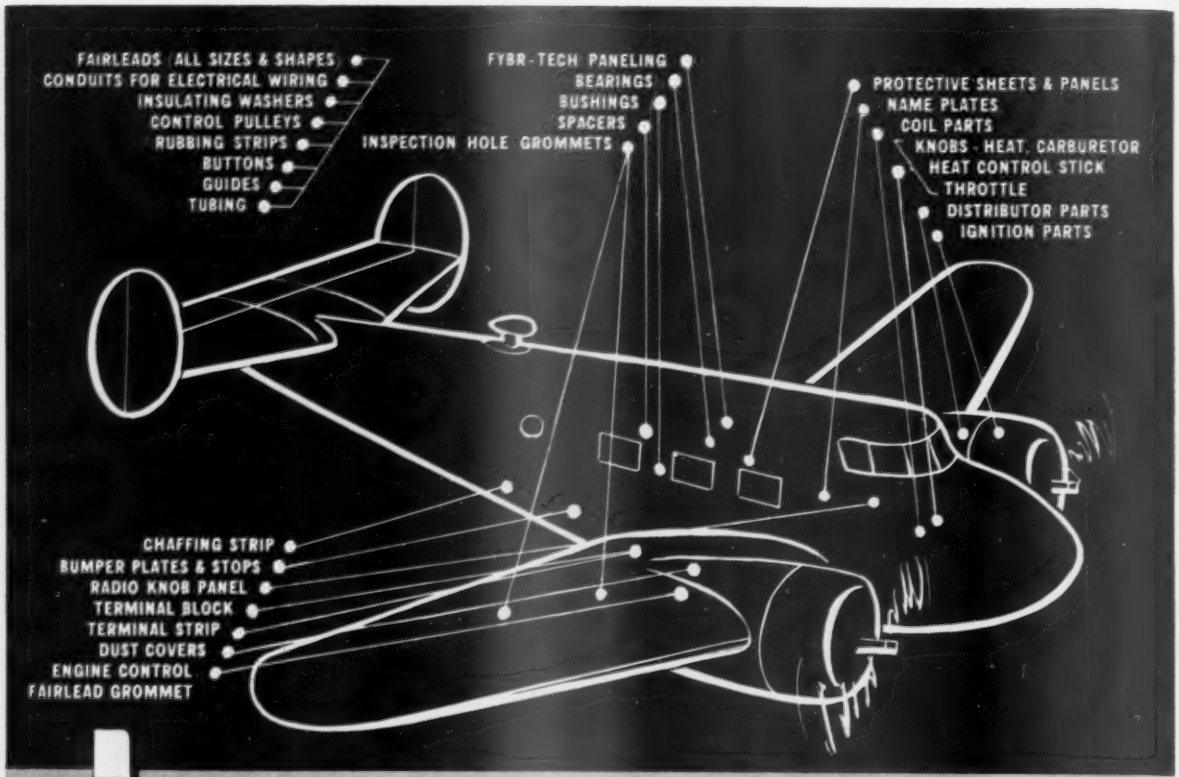


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competition is explained and some notes on the quantity manufacture of airplanes are added. The writer concludes by stating that in war nothing is good enough, and there is endless room for improvement in what is being done and the way in which it is being done. *Mechanical Engineering*, June, 1942, pages 470–472.

**Japan's Air Power.** V. L. Gruberg. First in a series of articles analyzing the present and potential aerial strength of Nippon. The point of view taken throughout is that whatever advantages Japan may have had in the initial battles will continue to decline throughout the war . . . . that surprise, preparation, and fifth-column work were allies of Japan in the beginning but that her equipment cannot equal that of the United Nations as they get into stride, either in quantity or quality. In spite of rapid expansion, Japan's war industry is dependent on a pattern of farmed-out work rather than a coordinated whole, it is stated, and her resources of skilled labor, man power and materials cannot keep pace with the necessary industrial replacement capacity.

After comment on Japan's former reliance on foreign designs and benefits received from British and American "appeasement" suppliers, several new types of Japanese aircraft are noted. An accompanying table gives the general description, dimensions, power plant, performance and armament of her representative airplanes. This table indicates that while few are equipped with twin-row radials none have power plants in excess of 1,000 hp.

The second of this series of two articles describing Nipponese aircraft and evaluating Japan's air power, stating that the tendency for emulation is displayed both in the construction of engines and air frames, credits a great deal of the technical improvements in Japanese aircraft to the cooperation of Germany and Italy. The organization and training of the army and navy air forces are outlined. Included in the article are tables listing the types, general descriptions, dimensions, power plants, performances and armaments of Japanese fighters, torpedo aircraft, dive bombers, seaplane fighters, reconnaissance seaplanes, bombers and flying boats. These tables are based upon information obtained from the British Air Ministry. In a tabulation of aircraft and seaplane carriers, the class, number in service, tonnage, year of launching, speed and capacity are given. *Flight*, April 23, 1942, pages 392–397, 16 illus.; April 30, 1942, pages 431–434, 10 illus.

**Russia's Air Force.** An attempt is made to evaluate the air power of the Soviet Union based on available information from Great Britain and from Russian sources. The growth of the Russian air forces for the past five years is reviewed, with the increase in personnel being placed at 138 per cent; total number of aircraft, 130 per cent; and total horsepower, 213 per cent. A tabulation of percentage increases in the performance of various types is given, covering pursuit planes, short-range bombers, long-range bombers, and scout and battle airplanes. A comparison is made between the Soviet air forces and the British air forces. Brief comments are made on the naval air units. A brief history is given of the development of the Russian aircraft over a period of several years. Certain Russian aircraft and engines are said to have been taken from the designs of American, French, British and German manufacturers. It is stated that probably the latest types of fighters are the "I" series. Some details are given on the design and equipment of these aircraft, based on presumptions rather than on precise information. Similar information is given about dive bombers. *Indian Aviation*, January, 1942, pages 12–14.

*The irregularity of receipt of publications from abroad necessitates the review of articles in issues several months late. This is done to provide readers with information regarding foreign technical progress as soon as the issues are available in the United States.*

## Air Transport

**Air Lines.** A survey of the international air lines still operating despite the war, giving a graphic comparison of the air miles still being flown by the various powers. Interpretations of the names of standard lines and their division abbreviations are also given. *Aeronautics*, May, 1942, pages 34, 35.

**Freight Trains on Wings.** Edward S. Evans. Consideration is given in this article to the practical application of aircraft for the movement of freight in considerable volume. The necessity for accelerating the development of air transport of goods is pointed out in view of the present strain on the surface transportation facilities of the country. Figures are given on the relative capacities of aircraft and other means of freight movement. *The Detroiter*, May 4, 1942, pages 5, 6.

**Our Air Lines Accept Axis Challenge.** Organization and operations of the Army Air Service Command are narrated. The nation's air lines responded promptly when Gen. H. H. Arnold, Chief of the Army Air Forces, called upon them some months ago for counsel and assistance in organizing these task units. They developed systems for Army maintenance and mechanic training programs and plans for supplying fast transportation for men and materials. *U.S. Air Services*, May, 1942, pages 12–14, 2 illus.

**Flying the Airways of Canada—Part I.** Ewan D. Boyd. The first of a series of articles written for the benefit of the many new pilots who are not altogether familiar with the facilities provided for them by the Dominion Government's Department of Transport Air Services Branch. These articles have as an object a description of these aids and an explanation of their relationship both to military and civil flying. The first one treats of air traffic control and the uses of the D.T.A.S. radio range and broadcast stations. *Commercial Aviation and Aircraft Production*, May, 1942, pages 24–30, 10 illus.

**The Airlines Are Drafted.** Rowland Carter. With many of their pilots and ground crews and a major part of their equipment requisitioned for military purposes, the air lines are still striving to maintain their services to the nation by the adoption of emergency measures. It is shown how the commercial air lines have demonstrated their usefulness to the war program. *Flying and Popular Aviation*, July, 1942, pages 21, 62, 86, 88, 1 illus.

**The Handling of Flying Boats on the Water.** Capt. Fred Smith. Flying boats have individual peculiarities when handled on water, though these are not important if there is plenty of space in which to maneuver. Taxiing on the step is frowned upon by veteran pilots as lateral control is limited and the danger of striking objects in the water is increased. Mooring methods are discussed and advice is given on checking anchorage positions. *Aero Digest*, June, 1942, pages 73–75, 220, 2 illus.

## Aircraft Spotting

**Height Estimation.** J. S. Blair. This first installment of a two-part article offers suggestions on how ground observers can check their estimates of the heights at which airplanes are flying without using special height-finding instruments to aid their detection. Appearance of minor de-

tails, comparison with local landmarks, cloud heights, timing of sounds, speed and time, size of airplane and angle subtended are all taken into consideration.

The second part continues the discussion of methods used in ascertaining the height and position of aircraft in flight. It takes up the estimation by means of sound and when using binoculars. Cautions are given on points to be taken into consideration which may lead to error. *The Aeroplane Spotter*, April 9, 1942, page 88, 1 illus.; April 23, 1942, page 100, 2 illus.

**An Aeroplane Spotter Test.** Test questions are presented by which students of aircraft recognition and others can test themselves for proficiency in their work. Part 1 covers the recognition of numerous types of aircraft and Part 2 is devoted to the technique of aircraft spotting. *The Aeroplane Spotter*, May 7, 1942, page 112, 3 illus.

# Airplane Descriptions

**First Pictures and Diagrams of Jap "Zero."** Drawings and some unofficial specifications are presented on the Mitsubishi "00" or Zero obtained from various sources; this is said to be the first presentation in a United States periodical of specifications of this airplane, whose pilots are understood to have instructions to crash-dive or otherwise destroy it rather than let its secret design become known. Approximate dimensions and other features are given, as well as the armament, which includes two 7.7-mm. guns firing through a three-bladed propeller and two 20-mm. cannon in the wings. The latter constitute additional armament in case a disposable auxiliary fuel tank is not used. Service ceiling is said to be 36,000 ft. It is reported that two different power plants are used, a two-row, 14-cylinder Nakajima N.K.I. developing 900 hp. at 15,000 ft., or a two-row, 14-cylinder Mitsubishi Kinsei of 1,000 to 1,200 hp. Speed of about 315 m.p.h. is indicated with the smaller engine and about 350 m.p.h. with the larger. *Air News*, June, 1942, page 4, 4 illus.

**The Master III.** Description of the Miles Master III advanced trainer, a two-place, low-wing monoplane built entirely of spruce, plywood and other nonstrategic materials, powered by a 750-hp. Pratt & Whitney Wasp Junior. *Aeronautics*, May, 1942, page 26, 2 illus.

**Then and Now.** Contaire. Types of bombers and fighter aircraft built during the first World War are discussed. These include the Vickers Vimy, the Handley Page 0/400, the Bristol F2B, de Havilland No. 9a and the Bristol Snipe. *Aeronautics*, May, 1942, pages 27–29, 5 illus.

**Aircraft Used by the Japanese Air Force.** Brief descriptions of principal first-line Japanese aircraft, together with outline drawings, are presented in a short article. *Aero Digest*, June, 1942, pages 160, 163, 187.

**The "Spitter."** William Winter. Description, specifications, and performance records of the British fighter airplane, the Spitfire, are given in extensive detail. Tracing the evolution of these fighters from Supermarine racers to the Battle of Britain, the article shows how they have attained their reputation for maneuverability, speed, high-altitude flying, and armament. It compares their characteristics with those of similar types of airplanes manufactured by other countries and gives a brief biography of the designer, R. J. Mitchell. *Flying and Popular Aviation*, July, 1942, pages 30–32, 64, 66, 69, 104, 7 illus.

**An Analysis of German Warplane Construction.** Henry Lowe Brownback. General comments on the efficiency of German aircraft production and on the design, construction and workmanship of the airplanes are followed by a detailed study of several types including the Heinkel He 111 bomber, Junkers Ju 87 and Ju 88 dive bombers, Messerschmitt Me 109 and Me 110 fighters and the Dornier Do 17 two-engined bomber. The information is based on data issued by the British Ministry of Aircraft Production. Wing and fuselage construction details are the principal subjects of this article, which is illustrated by photographs and drawings from British aeronautical magazines. *Automotive and Aviation Industries*, May 15, 1942, pages 21–23, 76, 12 illus.

**Japanese and Italian Military Aircraft.** Information is presented in tabular form compiled from data released by the British Air Ministry and the United States Army Air Forces covering descriptions and available performance figures on Japanese and Italian military aircraft. The headings show the make and model of airplane, type, crew, construction, armament, engine details, dimensions and performance of army and navy aircraft of these nations. *Automotive and Aviation Industries*, May 15, 1942, page 43.

**British Defiant Night Fighter.** M. W. Bourdon. A description of the Boulton Paul Defiant two-seater fighter, equipped with a power-operated four-gun turret. Data on the constructional features, recently released for publication in Great Britain are given along with the major specifications and dimensions. Details of the wings, flaps, turret and the hydraulic operating mechanism are revealed. *Automotive and Aviation Industries*, May 15, 1942, pages 18, 19, 70, 5 illus.

**New Fairchild Cornell.** The Fairchild PT-26, known as the Cornell, is discussed and some of its features are outlined. The airplane is being delivered to the Royal Canadian Air Force from the United States and is also constructed under license in Canada. It is a modification of the PT-19A trainer and is fitted with a 200-hp. Ranger six-cylinder in-line engine. *Aviation*, June, 1942, page 209, 4 illus.

**The Handley Page "Halifax" Bomber. No. II.** Crew accommodations, methods of construction, the landing gear, and the Handley Page Gyral bomb winches are described in detail in the second part of an article dealing with this heavy bomber. Its component parts are illustrated by a series of drawings and photographs. *The Engineer*, May, 1942, pages 364–366, 22 illus.

**The Halifax.** A prolonged and detailed account covering design and constructional features of the Handley Page Halifax. With the same wing span as the Handley Page 0/400 of 1915, this four-engined bomber has a 60,000-lb. loaded weight, more than three times the speed of the 1915 model and a much greater load-carrying capacity. One full-page diagram plus several smaller ones help to illustrate this explanation. *Flight*, April 23, 1942, pages 398, 398a, 398b, 399–405, 22 illus.; *The Aeroplane*, April 24, 1942, pages 465–470, 12 illus.

**Axis Aircraft Tabulated.** From information supplied by the British Air Ministry data in tabular form are presented on 28 types of German and Italian airplanes. Together with remarks on each airplane, figures are given on the span, length, wing area, normal flying weight, engines, armaments, bomb loads, top speeds, cruising speed, range, and service ceilings of Axis bombers, fighters, floatplanes, and army cooperation aircraft. *Flight*, April 16, 1942, pages 377, 378.

**Douglas Boston III.** Some constructional and operational facts on the Douglas Boston III, employed by the British as a close-support and precision day bomber, as interpreted by a British publication. First bomber with a tricycle undercarriage to be used by the Royal Air Force, this

twin-engined mid-wing stressed-skin monoplane is designated as the fastest of the twin-engined lend-lease bombers. *Flight*, April 16, 1942, pages 372, 373, 4 illus.; *The Aeroplane*, April 17, 1942, pages 448, 449, 4 illus.

**A 1,700 H.P. Dive Bomber.** Description of the Curtiss-Wright Helldiver, (SB2C-1 dive bomber). Designed to operate from aircraft carriers on extended scouting and bombing missions, the Helldiver is powered with a 1,700-hp. Wright Cyclone engine. It is claimed that this two-seater, all-metal monoplane will transport a larger bomb load at a higher speed for greater distances than any other dive bomber ever developed. *Flight*, May 7, 1942, page 454, 2 illus.

**Official Information.** Data on twelve German airplanes, as released by the British Air Ministry. Information is given regarding duty, crew, general description, power plant, airscrews, armament, armor, dimensions and performance, with added special notes. Described in this manner are the Dornier Do 217 bomber; the Heinkel He 111 bomber; the Junkers Ju 88 bomber; the Junkers Ju 88 night fighter; the DFS 230 glider; the Gotha Go 242 glider; the Focke-Wulf FW 200K bomber; the Junkers Ju 52 transport and glider tug; the Heinkel He 113 single-seater fighter; the Messerschmitt Me 109F fighter; and the Messerschmitt Me 110 twin-engined fighter. *The Aeroplane*, April 17, 1942, pages 438, 439, 10 illus; *Air News*, June, 1942, pages 32, 33, 4 illus.

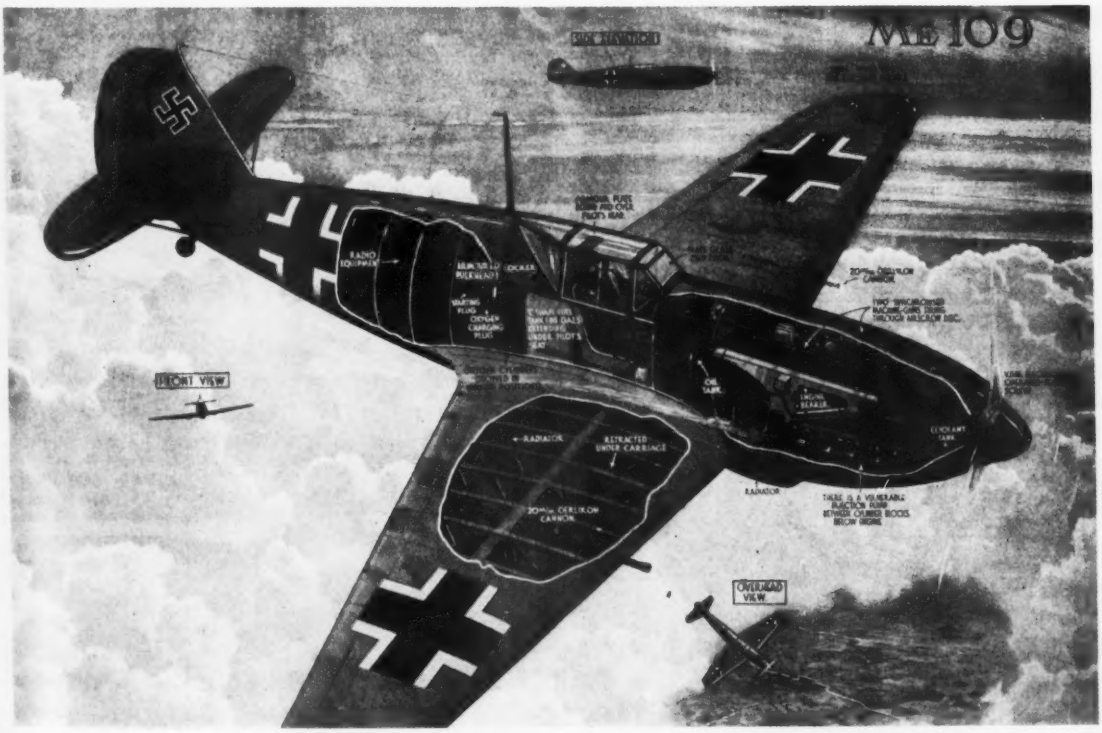
**German Warcraft Analyzed by Air Forces.** Information released by the British Air Ministry is presented in tabular form covering numerous German war airplanes, including the Focke-Wulf FW 189 army cooperation and FW 200K bomber; Junkers Ju 88 dive bomber and Ju 88 night fighter, Ju 90 transport, Ju 52 transport and glider tug, Ju 87 dive bomber; Heinkel He 113 single-seater fighter and He 111 bomber; Messerschmitt Me 109F fighter and Me 110 twin-engined fighter; Dornier Do 217 bomber; Gotha Go 242 glider; DFS 230 glider; and the Henschel Hs 126 army cooperation.

The headings under which the information is tabulated include the dimensions, duty, crew, general description, engines, airscrews, armament, armor, performance and details of special equipment such as the diving brakes. *American Aviation*, May 15, 1942, pages 3, 13, 14, 9 illus.

**The Boulton Paul Defiant.** Considerable detail is given of the construction and assembly of the Boulton Paul Defiant, illustrated by photographs and sketches of the various parts of the aircraft and of the mechanisms used in its production. In this article major attention has been given to the air-frame parts, with a brief description of the hydraulic and pneumatic systems and the power plant. *Aircraft Engineering*, April, 1942, pages 99–102, 13 illus.

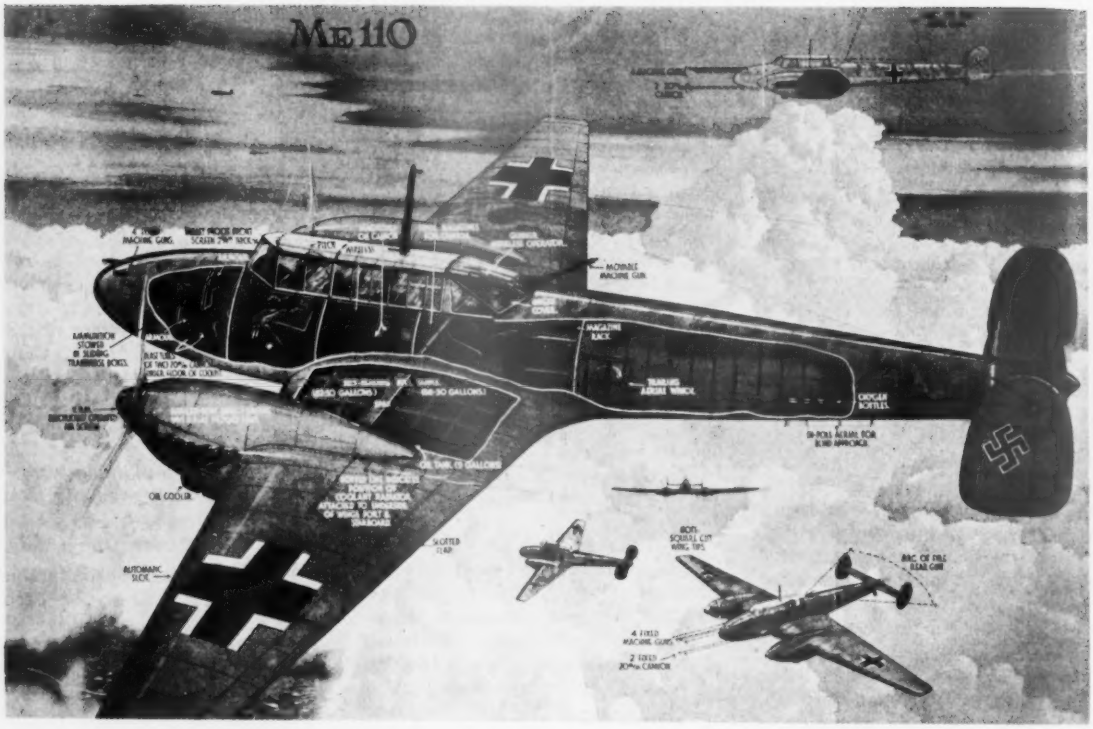
**Aircraft and Engine Review.** The *Third Annual Aircraft and Engine Review* for 1942 is a directory of both Allied and Axis aircraft. It includes descriptive details of: (1) American civil aircraft; (2) American military aircraft; (3) British and Canadian military aircraft; (4) German, Japanese and Italian aircraft; (5) American aircraft engines, and (6) British aircraft engines. *Commercial Aviation and Aircraft Production*, May, 1942, pages 32–34, 36 and alternate pages to 50, 53, 54 and alternate pages to 94, 96 illus.

**Italian Warplane Specifications Revealed.** Illustrations and specifications are presented of Italian military aircraft based on information released by the U.S. Army Air Forces and the British Air Ministry. Specifications are set forth in uniform tabulations covering such information as dimensions, duty, crew, general descriptions, engines, airscrews, armament, performance and other special data.



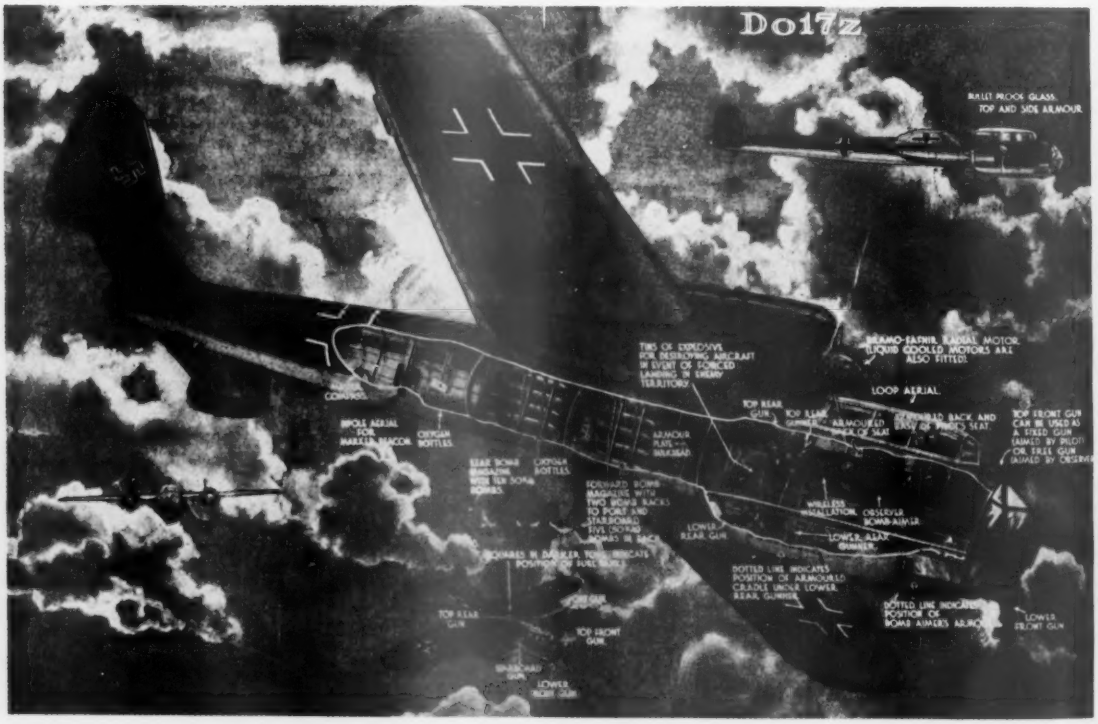

*Official photograph, U.S. Army Air Corps.*

The Messerschmitt Me 109




*Official photograph U.S. Army Air Corps.*

The Messerschmitt Me 110.

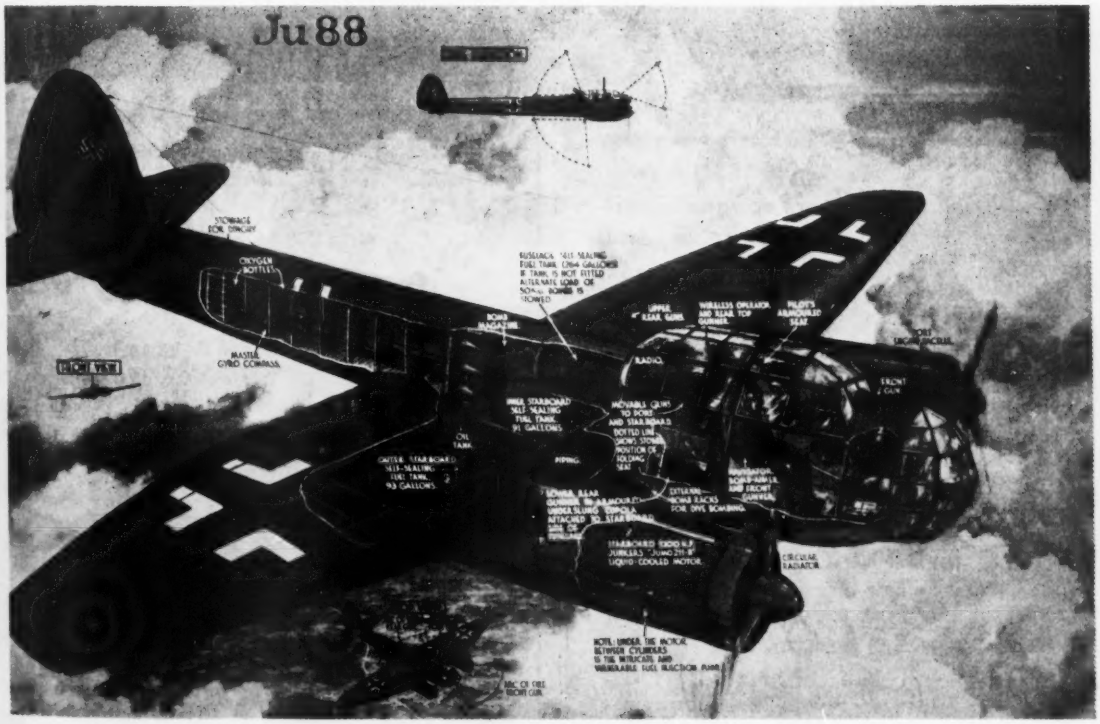



*Official photograph U.S. Army Air Corps.*

The Dornier Do 17Z.

*Official photograph U.S. Army Air Corps.*

The Heinkel He 111.




*Official photograph U.S. Army Air Corps.*

The Junkers Ju 88.

*American Aviation*, June 1, 1942, pages 4, 6, 9, 8 illus.; *Aviation*, June, 1942, pages 78, 79, 28 illus.

**The Spitfire in Production. Part II.** Wilfred E. Goff. This concluding installment is concerned mainly with the construction of the Spitfire's three-section fuselage. These sections consist of the tubular engine mounting, the fuselage of construction, monocoque, and the rear portion incorporating the fin as an integral part. Supplementing the description of the manufacture of these components and the assembly of the control surfaces of the tail unit, a summary of the final assembly operations is given. *Aircraft Production*, May, 1942, pages 332–342, 26 illus.

**Japan: First-Line Types.** Brief descriptions of Japanese first-line aircraft, together with some estimated and actual performance data. *Interavia*, December 13, 1941, pages 14–16, 6 illus.

**U.S.A.: Bell "Airocobra."** For comparison, the weight distribution of the original Bell P-39, released for export in 1940, is contrasted with the present-day first-line type. *Interavia*, December 13, 1941, page 17.

**U.S.A.: Langley Touring Aeroplane.** The treatment of Honduran mahogany by the Vidal process and the plastic construction of the Langley four-seater monoplane are described. *Interavia*, December 20, 1941, page 12.

**Great Britain: Long Range Bombers.** The Short Stirling, Handley Page Halifax and Avro Manchester are compared. Details recently released by the British authorities are included. *Interavia*, December 20, 1941, pages 13–15, 5 illus.

**Germany: Klemm Kl. 107.** The Leichtflugzeugbau Klemm G.m.b.H., of Stuttgart-Boblingen has developed a new two-seater fitted with a Hirth 105-h.p. four-cylinder, air-cooled, in-line engine. The airplane, built entirely of wood, is of semimonocoque design. *Interavia*, January 22, 1942, page 11, 2 illus.

**Great Britain: De Havilland "Hertfordshire."** Additional details, including dimensions, describing the de Havilland Hertfordshire twin-engined, 22-seater troop-carrier supplementing those previously published in *Interavia* (Nos. 666 and 679). *Interavia*, January 31, 1942, page 12.

**Italy: Piaggio P-108C.** Brief mention is made of a new substratosphere four-engined air liner recently built by S. A. Piaggio of Italy. An outline drawing is reproduced. *Interavia*, January 31, 1942, page 14, 1 illus.

**Germany: Bucker Bu 181 "Bestmann."** Characteristics and performances of the Bucker Bu 181 Bestmann two-seater trainer. *Interavia*, January 31, 1942, page 14, 1 illus.

**Germany: Bombers.** Unconfirmed details on Dornier Do 217 and Junkers Ju 288 twin-engined bombers. *Interavia*, January 31, 1942, pages 13, 14, 1 illus.

**U.S.S.R.: I-18 Fighter.** Additional details to supplement descriptions already published in *Interavia* (Nos. 772–773, 779–780) of the single-seater fighter, derived from the I-17. *Interavia*, February 10, 1942, page 16.

**Japan: Bomber and Reconnaissance Two-Seaters.** Further details on Japanese first-line types adding to descriptions that have previously appeared in *Interavia* (Nos. 794–795). *Interavia*, February 10, 1942, page 16.

**Great Britain: Long Range Bombers.** Comparative details on the Short Stirling and Handley Page Halifax show that a considerable amount of liberty is still granted to individual constructors with regard to design conceptions of their aircraft. It is stated that the general impression received is that the Halifax has better equipment and its pilot's cabin is more carefully planned. *Interavia*, February 27, 1942, pages 9, 10, 2 illus.

**Germany: Dornier Bomber.** Notes on the armament and equipment of the Dornier Do 215 twin-engined bomber as used on the Eastern Front.

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*Interavia*, February 27, 1942, page 10, 1 illus.

**U.S.A.: Vought-Sikorsky VS-44 and VS-44A.** A comparison is made between the four-engined transport flying boat designed for American Export Airlines, and its Navy counterpart. Estimated performance figures are given. *Interavia*, February 27, 1942, page 12.

**Germany: Dornier Do 217.** Details, derived from an unnamed British source, concerning nacelles, power plant, armament and armor protection of the Dornier Do 217 twin-engined bomber. According to the British reports, the Do 217 is fitted with slotted ailerons and split flaps designed in a novel manner so that in the deflected position they form a duct in conjunction with the fixed portion of the wing situated above them. *Interavia*, March 9, 1942, pages 5, 6.

**France: Bloch 161 and 162.** Tests of the four-engined transport, the Bloch 161, have been resumed in Unoccupied France. It is reported that Air France is considering an order for 30 of this type. A derivation for long-range bombing, the Bloch 162 is nearing completion. It is indicated that they will be powered with four Hispano 14AA twin-row radial engines developing 1,100 hp. at 13,000 ft. and will have a gross weight of approximately 44,000 lbs. *Interavia*, March 9, 1942, page 8.

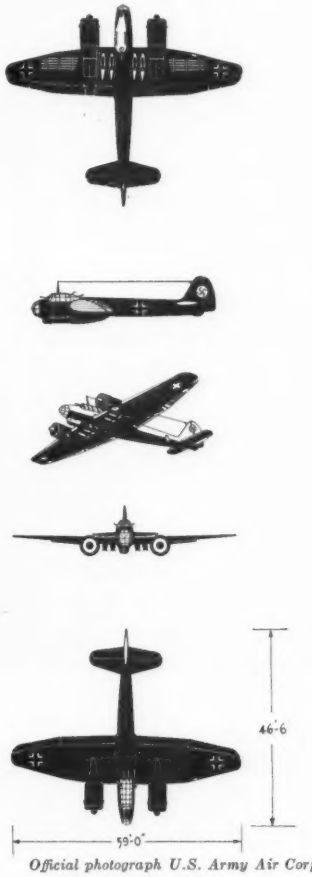
**Great Britain: Boulton Paul "Defiant."** Details on the construction of the two-seater night fighter that first saw action in 1940. The construction of the wing and fuselage is characterized by the extensive use of "developable" (conical) surfaces containing no double curvatures; prior to the final assembly the stressed skin can thus be riveted on the flat to the mainly Z-section longitudinal stringers. *Interavia*, March 9, 1942, pages 9, 10.

**Great Britain: Miles "Master III."** This new version of the British trainer is fitted with a Pratt & Whitney Twin Wasp Junior engine for the purpose of giving British pilots experience with United States engines. Weight, dimensions and performance figures are given. *Interavia*, March 9, 1942, page 10.

**Great Britain: Westland "Whirlwind."** Unofficial data are presented in a brief description of the Westland Whirlwind single-seater, twin-engined fighter. The machine, built under license in Canada, will be fitted with the latest Rolls-Royce Merlin engines which develop 1,300 hp. each, produced by the Packard Motor Car Company of Detroit. It is also rumored that some component parts of the machine are to be made of plastics-improved plywood to save aluminum. *Interavia*, March 16, 1942, pages 5, 6, 2 illus.

**Great Britain: Westland "Whirlwind."** Some characteristics are given with a brief description of the Westland Whirlwind single-seater, long-range fighter fitted with two Rolls-Royce Peregrine engines of 885 hp. each. *Interavia*, March 28, 1942, page 13, 4 illus.; *Model Airplane News*, July, 1942, pages 27, 45, 46, 2 illus.; *Canadian Air Cadet*, May, 1942, page 8, 3 illus.

**Great Britain: Bristol "Beaufighter II."** The latest version of the Beaufighter twin-engined fighter is




*Official photograph U.S. Army Air Corps.*
Junkers Ju 88A-1.

fitted with Rolls-Royce Merlin XX liquid-cooled, twelve-cylinder engines of 1,260 hp. each. It is said that Beaufighter I has so far been fitted with the Bristol Hercules III air-cooled, twin-row, sleeve-valve engine of 1,400 hp. *Interavia*, March 16, 1942, page 6, 1 illus.

**Great Britain: Hawker Typhoon.** It had been reported that flying tests were started on the Hawker Typhoon single-seater fighter in 1940 and that the machine was scheduled to go into production in the summer of that year fitted with the new Napier Sabre 24-cylinder "H" engine of about 2,350 hp. It is stated that apparently the Typhoon has yet to be placed in production because of the necessity of modifying the prototype. The British Air Ministry has announced that the machine has been flight-tested and that the top speed exceeded 400 m.p.h., the Under Secretary of State for Air declaring that it is the fastest fighter ever produced in Britain. *Interavia*, March 16, 1942, page 6.

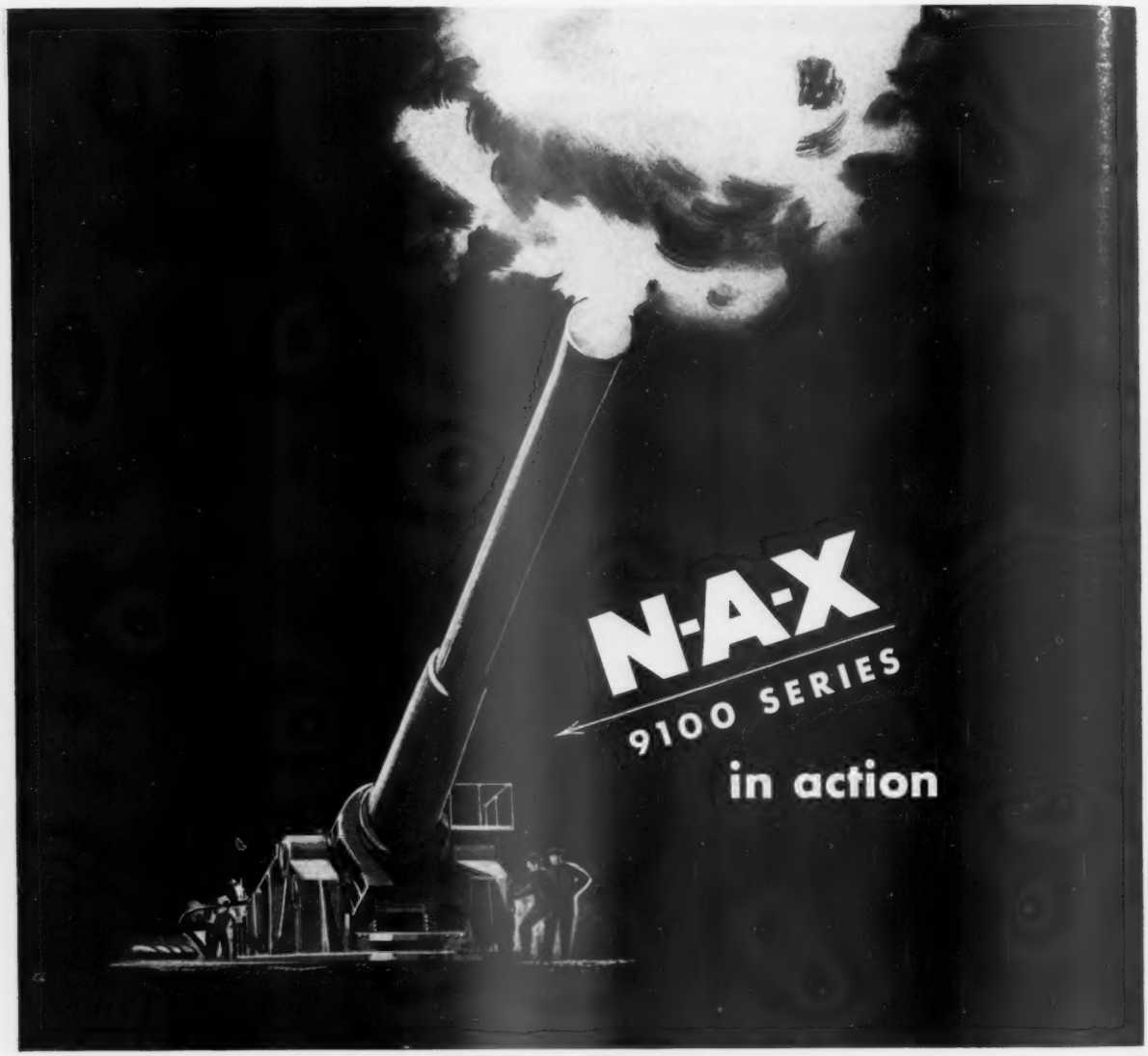
**Germany: Blohm & Voss BV 222.** According to an unnamed British aviation periodical, Blohm & Voss have completed several BV-222 six-engine flying boats, which are being used for long-range reconnaissance. The BV-222 is said to weigh 45 tons and to have a range of approximately 4,400 miles. Cruising speed is said to be 170 m.p.h. and the maximum speed is given as 199 m.p.h. The BMW radial engines are of 1,000 hp. each. *Interavia*, March 16, 1942, page 9.

**U.S.A.: Douglas B-19.** According to an Allied aeronautical press source, the bomb loading of 26,000 lbs. at a gross weight of 140,000 lbs. must not be considered as the maximum load for the B-19. It is reported that the structure is stressed for a gross weight of 160,000 lbs., so that the load can be increased by the installation of more powerful engines. *Interavia*, March 28, 1942, pages 16, 17.

**This Is the Red Air Fleet.** A survey of Russian air power, including a compendium of the better-known Russian types of airplanes and some of their specifications and characteristics. A brief outline is also given of the organization of Russia's air forces. *Canadian Aviation*, May, 1942, pages 23–25, 71, 16 illus.

**PR-GI Spreads Its Wings.** Parker Leonard. A report is given on an official test of a Pratt Read trainer sailplane. A description of the aircraft is included and a three-view drawing shows the principal dimensions and other specifications. *Soaring*, March–April, 1942, pages 2, 3, 9, 2 illus.

**Globe Gets ATC on Swift.** Technical description, specifications, and performance data on the Swift, a two-place, low-wing monoplane with retractable landing gear and controllable pitch propeller, manufactured by the Globe Aircraft Corporation at Fort Worth, Tex. Designed to sell in the $3,000 class, the Swift has a 29-ft. wingspread, a maximum speed of 138 m.p.h. and a cruising speed of 128 miles. It is powered by an 80-hp. Continental engine. With fuel consumption of less than 5 gal. per hour, its 20-gal. tank furnishes a cruising range of about 530 miles. *Southern Flight*, May, 1942, pages 62, 70, 2 illus.

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## Airports

**Separate "Maintenance Airports" Suggested.** E. J. Foley. A discussion of the functions of an airport which develops major considerations including convenience to the metropolitan business area, the value of the airport as a graphic sales advertisement for aviation, etc. The writer suggests that it would be advisable to separate the service and maintenance departments from the operational sections of the airport, just as a railroad shop is removed from the passsenger terminal and a shipyard is located far from the pier where the passengers embark. He suggests an airliner roundhouse or drydock, entirely separate from the terminal, and indicates the advantages that would result. *American Aviation*, June 1, 1942, pages 36, 38, 4 illus.

## Armament

**Aircraft Armour and Development Trends in Aircraft Construction.** Camille Rougeron. Armor protection requirements will impose radical modifications on the power plant and also on the air frame itself. In Flying Fortresses of tomorrow the writer says that the power plant will be concentrated in front of the pilot, will protect the latter and be protected in turn by armor plates. Smaller crews will be closely grouped behind a mutual armor protection. *Interavia*, February 10, 1942, page 1–5.

**Aircraft Machine Gun and Aircraft Cannon.** Camille Rougeron. Aircraft armament problems of World War I are discussed. Experiences with machine gun and cannon armaments of World War II are recounted. Prewar expectations of the efficiency of the aircraft cannon, it is claimed, appear to have been exaggerated. *Interavia*, January 22, 1942, pages 1–5.

**Today's Air Guns.** Frank Tinsley. Drawings and captions show some of the details of modern guns and their mountings on airplanes. Examples include the Messerschmitt Me 110, the Hawker Hurricane II, the Curtiss 75A delivered to the French with Madsen machine guns, the Blachburn Botha, the Bristol Beaufort, and various other British, Russian and German units and their gun equipment. Diagrams compare the effective range of different guns. *Air Trails*, July, 1942, pages 20, 21, 17 illus.

## Avigation

**Observations—Celestial and Otherwise.** Kenny Baetz. Some comments, translations of terms, and explanations of celestial navigation as it appears to a trans-Pacific copilot. *Western Flying*, May, 1942, pages 36, 41, 64, 6 illus.

**Astral Aircraft Navigation.** Prof. J. W. Melson. A study of the fundamentals of aerial navigation, considering the changes and simplifications that have been effected in order to make their application easier to teach and use. The article explains the principles of the location of substellar points and the circle and line of position and other basic considerations, examines the characteristics of maps and charts and gives directions in laying out distances on them. The meaning and difference between solar and sidereal time and their application to the solution of specific avigational problems are also given. *Canadian Aviation*, May, 1942, pages 40–45, 68, 71, 9 illus.

*Official photograph U.S. Army Air Corps.*
Junkers Ju 87B.

## Blind Flying

**Instrument Landing Systems Will Aid War Effort.** A. C. Preil. How the air lines and U.S. Air Forces are collaborating with the C.A.A. and other interested parties in the development of standard instrument landing systems. Instrument installations are being commissioned at Washington, Oakland and Atlanta, the original installation at Indianapolis having been commissioned in 1939. Other plans and installations are outlined. *Aviation*, June, 1942, pages 197–199, 2 illus.

## Business and Finance

**Who Said War 'Profits'?** Ward Hill. A refutation of any charges that huge profits are being made by the aircraft industry. With the Douglas Aircraft Company as a yardstick, some of the profit limitations related are: taxes, tooling expenses, new machinery and equipment, research, expanding facilities, higher wages, rising cost of materials, surplus working capital to meet Government demands for new airplanes of various types, emergency wartime expenditures, and voluntary limitation of profit percentage on Government contracts. *Flying and Popular Aviation*, July, 1942, pages 33, 34, 98, 100, 1 illus.

## Civil Air Defense

**The C.A.P. Gets to Work.** A report on the activities of the Civil Air Patrol and the part it is playing in the war effort. *Yankee Pilot*, May, 1942, pages 11, 14, 1 illus.

## Civil Aviation

**Aviation After the War.** Col. John H. Jouett. A prediction of the future of military, commercial and private flying places the annual business of the aviation industry after the war at a figure of $600,000,000. The prediction of a strong future for the industry is based upon the maintenance of modified military air forces, foreign market potentialities, and a great increase in air transport and freight. In setting forth his belief that the lessons now being learned in war will produce great peacetime developments, the writer includes a comparison with the last postwar period when aeronautical activity was curtailed. *Flying and Popular Aviation*, July, 1942, pages 24–26, 76, 79, 4 illus.

**Reconstruction.** Problems involved in the reconstruction of civil aviation after the war are taken up and the development of air transportation in the years prior to the war are traced. It is stated that policies of Government will have to be arranged to provide for the expansion of civil air transportation. A broad policy of international cooperation is indicated. *Air Mail Magazine*, May, 1942, pages 774–778.

**The Strange Case of Civil Aviation.** A plea for a fair appraisal of civil aviation's resources for full and complete utilization in the war effort.

Acknowledging the Army's call for 2,000 Civilian Pilot Training instructors and the Civil Air Patrol's submarine-hunting assignment on the Eastern seaboard as a beginning, the potentialities of the Civilian Pilot Training program and the Civil Air Patrol are discussed. The enlargement of the Civil Pilot Training program, it is emphasized, is one effective way of encouraging enlistments in the air force which is not being accorded the full consideration it merits. *Southern Flight*, May, 1942, pages 27, 28, 1 illus.

**The Future of Civil Aviation.** "Planthair." The third in a series concerning aviation after the war. Prefaced by observations indicating design and manufacture as having been too slow in the past, this installment discusses production of civil aircraft after the war and the possibilities of conversions from military types. Expressing surprise that the Royal Air Force is not requisitioning some type of troop-carrier at the present time, the writer states that besides the advantages presented by this kind of airplane during the war it would greatly simplify the later conversion problem. On the other hand, reasons are offered why the usefulness of the converted bomber is apt to be limited. With acknowledgment made that the supply of civil aircraft will be exceptionally low and the demand for air transportation exceptionally high in the immediate postwar period, it is submitted that the general characteristics of the new airplanes should be left to the operators. The discussion also includes consideration of a new type of engine that may be required, radio equipment, and airports. *Flight*, April 16, 1942, pages 374–376.

## Control Equipment

**Remote Controls for Aeroplanes.** R. Hadekel. A discussion of remote controls classified into three groups—mechanical, fluid and electrical. The second and third group are subdivided into two classes: controls that depend on metering and controls that depend on an inherent tendency of the transmitter and receiver to maintain synchronism. *Aircraft Engineering*, April, 1942, pages 106, 107, 1 illus.

## Design

**Lookout From Aircraft.** A. Falorde. A study of various general designs of aircraft made from the point of view of maximum visibility. The single-seater monoplane and biplane are compared as to blind and open spots, and it is concluded that aside from certain performance disadvantages the biplane's inferior visibility bars it from further development as a fighter craft. Various types of flying boats are also compared. *Aeronautics*, May, 1942, pages 58, 59, 4 illus.

**Comfortization of Military Aircraft.** Albert A. Arnhym. The development of comfortable passenger and crew accommodations in commercial aircraft is briefly reviewed. The writer contends that with more comfortable accommodations on military aircraft, the crews can perform their functions more efficiently. A suggestion is made that some of the comforts afforded air-line passengers could be installed on military aircraft. These are considered as required for the physical fitness of military crews and include: (1) adequate air supply; (2) heating; (3) fighting comfort; (4) seating and resting; (5) soundproofing; (6) lighting; (7) food; (8) lavoratory facilities; (9) ease of motion. *Aero Digest*, June, 1942, pages 188, 190, 195, 196, 199, 200, 202–204, 206–208, 211, 5 illus.

**Lofting Problems of Streamline Bodies—Part 7.** Carter M. Hartley and Roy A. Liming. Calculations related to the second-degree curve development based primarily upon

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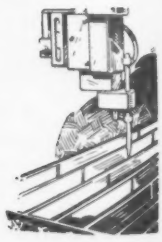

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parametric entities and which would require considerable effort and time under normal methods of computation can be quickly resolved by the use of appropriate formulas. The article is a discussion in which certain parametric formulas are presented which have been derived for convenient computation and time-saving in the mathematical application of certain features of the second-degree curve development. *Aero Digest*, June, 1942, pages 164, 169, 4 illus.

**The Automotive Body Engineer in Aircraft.** John C. Widman. Comparisons are made between the work of the designing engineer in the automotive industry and in the aircraft industry, with special reference to the functions of the body designer. The new problems encountered in transferring to aircraft work are mentioned. *S.A.E. Journal*, June, 1942, pages 209–211.

**Tactics and Unorthodox Aircraft.** Major Oliver Stewart. It is stated that the British depend mainly on conventional design for the majority of their military aircraft. Tactical innovations, however, have been made possible by the adoption of unorthodox design with good results, as in the case of modern armaments. Power-operated turrets are credited to the British as a bold, unconventional design feature. Other advantages held by the Royal Air Force are outlined. *Aviation*, June, 1942, pages 76, 77, 3 illus.

**Great Britain: Short "Stirling."** Brief note describing the exhaust pipe flame arresters and air-intake scoop as installed on nacelles of four-engined Short Stirling heavy bombers. *Interavia*, January 31, 1942, page 12, 1 illus.

**What We Learned From the B-19.** Edward Churchill. An analysis of the significance of the B-19—called the largest bomber in the world—shows its usefulness as a flying laboratory to be more important than its usefulness in combat. In determining the importance of the B-19 from structural, weight control and aerodynamic standpoints, engineers at the Douglas Aircraft Corporation who helped build the bomber are quoted. Conclusions arrived at are that: from a structural standpoint, experience with the B-19 indicates that possible size in airplanes will not be limited; from a weight control standpoint, the B-19 provides an upper limit for weight-estimating formulas and a basis for predicting more accurately the weight and balance of future heavy bombers; from an aerodynamics standpoint, the size of the B-19 offers new possibilities for the testing of flow conditions. *Flying and Popular Aviation*, July, 1942, pages 50–52, 79, 4 illus.

# Engines

**Theoretical Consideration of Power Loss Caused by Combustion Knock.** C. W. Good. A theoretic analysis is presented to show that the power loss that accompanies combustion knock and which has been attributed to radiation is actually a result of mass vibration of the gases within the combustion chamber. It is demonstrated by equations based on perfect gases that, on the assumptions made, the rise of pressure under normal combustion is proportional to the quantity of charge burned. The equations also show the loss in effective pressure which is caused by the vibration that results when combustion in the zone of detonation is so rapid that there is insufficient time for the pressure to equalize. The energy of vibration is not effective in pushing the piston outward and to that extent represents a power loss, while there is further loss in the heat transferred to the chamber walls because of this vibratory motion. Studies are made of both the Otto cycle and the Diesel cycle, and the relative theoretic losses for the two cycles are indicated. It is found that the loss with the Diesel cycle is relatively less than with the Otto cycle. The effect of differences between actual and assumed conditions is also indicated by the writer. *Transactions of the A.S.-M.E.*, May, 1942, pages 317–321, 8 illus.

**Forged Cylinder Head Developed by Wright.** A new technique which it is claimed, will speed production and allow a 12 to 15 per cent power increase in engines without an increase in weight has been developed by Wright Aeronautical Corporation. In fabricating the forging for the cylinder head, aluminum bar stock is extruded, then sections of the extruded bar are pressed in a die to final shape. Other advantages of the process are related. *Aviation*, June, 1942, pages 113, 263, 4 illus.; *Aero Digest*, June, 1942, pages 141, 142, 6 illus.

**Merlin "Twenty."** A description of the Rolls-Royce Merlin XX engine built by Packard Motor Car Company and some comparisons with the British-built Merlin X engine. The American Merlin XX is said to be similar in design to the British engine with the exception of the two-piece cylinder block. The two-speed supercharger adds slightly to the length and it is reported that the rated output of 1,260 hp. represents an increase of 16.3 per cent over the Merlin X. Some details of construction are included. *Aviation*, June, 1942, pages 207, 255, 2 illus.

**Cylinder Wear and Liner Materials.** R. A. Collacott. A study of the cause and prevention of cylinder wear and of the composition and manufacture of cylinder liners and the factors producing erosion in them. Methods for minimizing wear in the liners by hardening and surface finishing are suggested. *Aeronautics*, May, 1942, pages 32, 33, 4 illus.

**Mercedes-Benz D.B.601N.** G. Geoffrey Smith. Details obtained from an examination of specimens of this engine from airplanes shot down over England are published through the courtesy of the British Air Ministry. Features of the engine include a variable-speed supercharger, direct fuel injection into each cylinder by mechanical pump and injectors, and the inverted "V" cylinder arrangement common to German engines of the in-line type, with provision for firing a cannon through the propeller hub. This supplements descriptions that have appeared in recent months of British and United States engines of similar types. Internal details are discussed at considerable length, including the valve mechanism, the fluid drive for the supercharger, the connecting rods, the fuel injector, the engine auxiliaries and other parts. *Flight*, April 16, 1942, pages 365–369, 12 illus.

**Power Units of the Future.** John W. Morrison. A survey of the types of engines being built in the United States and Great Britain—supplemented by briefer consideration of the French, German, Russian, Italian, and Japanese types—shows the trend of development for the future. Although stating that the high specific power output of modern aircraft engines has been made possible by the development of high-octane fuels, reasons are given why the United States and Great Britain are not using 110 octane for the present. The writer challenges the wisdom of designing highly loaded engines, even if they were made possible with 110-octane fuel. It is his opinion that after considering a large number of advanced installations for fighters, bombers and other types, an output of 200 hp. per cylinder for take-off is sufficient to meet most requirements. *Flight*, May 7, 1942, pages 447–451, 9 illus.

**Great Britain: Rolls-Royce "Mer-**

# Round trip to Tokyo

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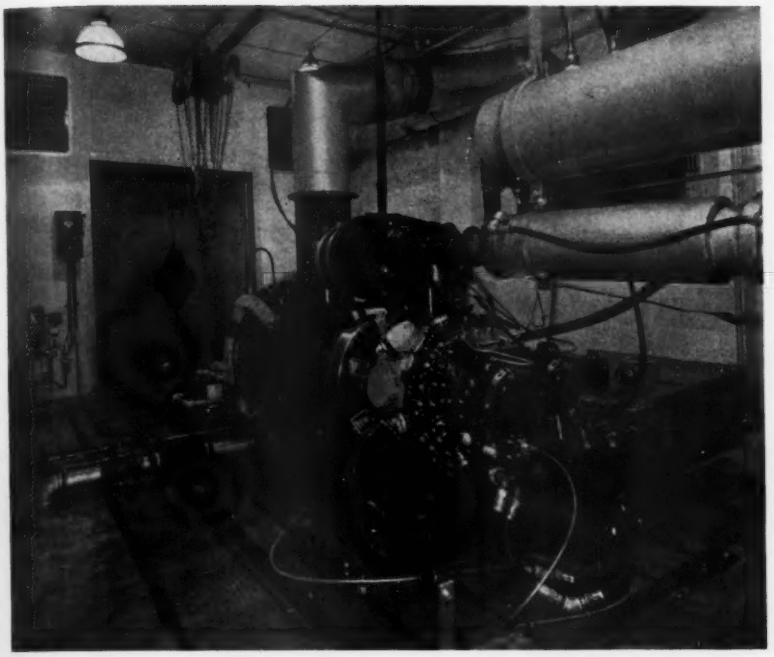

A single cylinder test stand of the Wright Aeronautical Corporation. View shown here is from rear of engine with single cylinder visible on top of a crankcase for a Cyclone 9. As can be seen, other cylinders are blocked off.

lin XX." It has been revealed that although the new Rolls-Royce Merlin XX is now in production manufacture of the Merlin X is being continued in Britain. The British-built Merlin XX differs somewhat in design from that built by the Packard Motor Car Company of Detroit. The Merlin XX is said to be characterized both in Britain and in the United States by an improved supercharger design and the inclusion of a larger twin-choke updraft carburetor. The maximum power of the British engine in low supercharger gear at 3,000 r.p.m. is stated at 1,260 hp. at 12,250 ft. Further characteristics are included in this brief description. *Interavia*, March 16, 1942, pages 6, 7.

**U.S.A./Great Britain: Coolants.** The engine coolant generally used by the Royal Air Force is composed of 30 per cent glycol and 70 per cent water under a pressure of 15 lbs. per sq.in. The British are said to have discovered that ethylene glycol is inflammable under certain conditions, particularly in the case of the coolant jackets being punctured by bullets. *Interavia*, January 22, 1942, page 13.

**U.S.A.: Wright High-Performance Flat Engine.** Contrast is made between existing flat engine types and a projected 32-cylinder, horizontally opposed, liquid-cooled Wright engine, which will feature banks of four cylinders—one set of two banks each, one bank arranged above the other to form an angle of 30 deg. The engine will be expected to develop 3,200 hp. The connecting-rod arrangement and other mechanical features are described in considerable detail. A drawing from the patent indicates the cylinder and crankcase arrangement. Mention is also made of earlier numbers (724, 725 and 763) referring to a possible Wright engine of 3,000 to 4,000 hp., having six radial rows of seven cylinders each. *Interavia*, March 28, 1942, page 16, 1 illus.

**Air Flow Through Intake Valves.** G. B. Wood, Jr., D. U. Hunter, E. S. Taylor and C. F. Taylor. A presentation of the results of flow tests made on various valve and port combinations in the Sloan Laboratory at Massachusetts Institute of Technology. Theoretic factors are discussed and a basis is developed for comparison of valve and port combinations of varying sizes and designs. It is shown that considerable improvement may be attained by comparatively simple modifications of conventional valve and port design. Among the recommendations are that all corners be rounded to reduce flow separation. Comparison of test conditions with actual operating conditions indicate methods for making and interpreting valve flow tests. *S.A.E. Journal*, June, 1942, pages 212–220, 252, 14 illus.

**What Happens Inside an Engine.** Vernon A. Pope. A brief and elementary description of the functioning of the four-stroke internal-combustion engine. *Canadian Air Cadet*, May, 1942, pages 11, 31, 3 illus.

**One Man: One Wrench: One Hour?** William B. Stout. More simplification and lightness are advocated for aircraft engines. The writer foresees an engine of such simple design that anyone can completely and quickly overhaul and service it. The modern machine gun, which can be taken apart with a dime for a screw driver, is cited as an example of simplicity. The necessity of building an engine with round parts for simplicity and cheapness is stressed. The possible use of one-piece round bearings and connecting rods, roller bearings, a built-up crankshaft and a minimum of bolts and nuts is urged. It is suggested that this hypothetic engine be able to receive a top overhaul by one man and one wrench in an hour as a goal of simplicity. Built in units of 100 hp. at the rate of 100 per day, the cost should not exceed $1.00 per hp. *Aero Digest*, June, 1942, pages 67, 68, 212, 215, 216, 3 illus.

## Equipment

**Improved Solutions of Remote Control Problems.** Herbert Chase. As military and civil aircraft increase in size, the problems of remote control are multiplied. This article shows that no single control system is completely immune from gunfire but that certain forms of light and compact electrically operated controls working in combination with mechanical drive are proving their usefulness. Various mechanisms are described, along with the operating methods used in such installations. *Aviation*, June, 1942, pages 97–101, 7 illus.

**Aircraft Control Systems.** Some informative data on various controls designed by R. Tampier, French inventor, now active in the Canadian aircraft industry. Discussions of flying controls, engine controls, several types of hinges, Anson controls, adjustment of friction, cable connections, and the Bolingbroke control box are included. *Canadian Aviation*, May, 1942, pages 36–39, 66, 9 illus.

## Flight Technique

**Forced Landings.** Alexander N. Troshkin. Reasons for forced landings are set forth to augment an admonition to pilots not to take off after forced landings due to powerplant difficulties, unless the trouble has been located and corrected. *Yankee Pilot*, May, 1942, page 17.

**The Technique of Flying in Rough Air.** Howard M. Cone. This ar-

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ticle is offered as a guide to the inexperienced pilot for rough-weather flying. It is stated that there are two types of instrument flying: precision instrument flying and maintaining the aircraft in level flight in turbulent air. The writer advises pilots: (1) to maintain constant safe air speed with vigilant use of elevators; (2) to keep the wings level; (3) to ignore the climb indicator under certain conditions; (4) to use changes in power to maintain a predetermined altitude; and (5) to maintain heading with turn indicator and directional gyro. *Aero Digest*, June, 1942, pages 106, 109, 110, 5 illus.

**Coordination in Aerobatics.** Casey Carl Ferrante. This article deals with aerobatic technique rather than particular maneuvers, though the execution of several of the latter is described. The writer claims that the basis of all flying maneuvers, both normal and aerobatic, consists of but two fundamentals—the turn and the roll. Several rules for coordination are set forth in the form of advice for the student. *Aero Digest*, June, 1942, pages 82, 232, 3 illus.

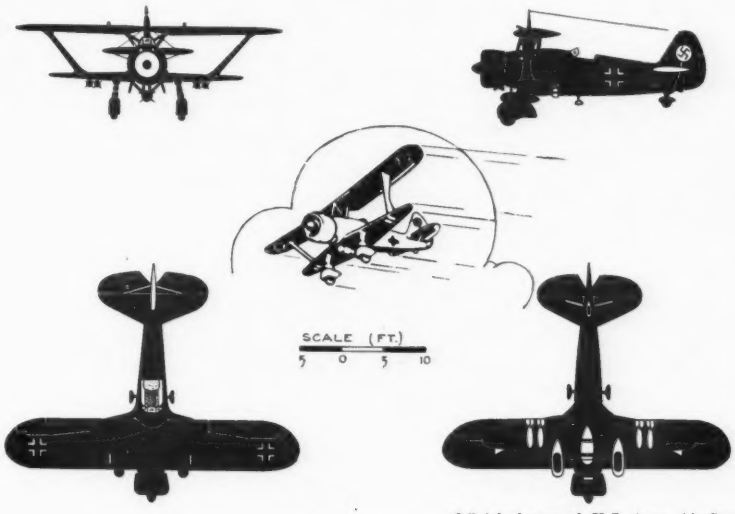
**Three Point Landing.** Wolfgang Langewiesche. An interpretation of the various techniques in correctly executing a landing whereby the airplane approaches the ground in a nose-high attitude and touches with all three points of support—main wheels and tail wheel—simultaneously. Supplementing the discussion on conventional three-point landings is a commentary on the advantages of tricycle landing gear. *Air Facts*, June, 1942, pages 38–52, 61.

## Fuels

**Light Plane Engines and Their Fuel Problems.** Carl T. Doman. Designers of light airplane engines are confronted with a serious problem as a result of the recent revision of gasoline specifications. At the same time, customers are demanding more power without an increase in cost or weight. Several approaches to these and other problems created by the use of lower-octane fuel are described: (a) increased displacement; (b) improvement in installations in aircraft; (c) improvement in induction systems; (d) changes in cam timing; and (e) improved cooling of the cylinder and piston. *S.A.E. Journal*, May, 1942, pages 188–195, 13 illus.

**International: The Petrol Supply.** A résumé of the fuel supply situation of the United Nations. Prewar and present sources of supply are described, as well as recent Axis efforts to cut them off. *Interavia*, March 9, 1942, pages 16–18.

**U.S. Aviation Gasoline.** Wright W. Gary. A discussion of the speed, power and maneuverability advantages accorded American aviation by the use of 100-octane gasoline including information on its components, facilities for its manufacture, and an optimistic prediction for its postwar utility. In citing the benefits of 100-octane fuel, it is credited with: developing approximately 25 per cent more power at take-off, maintaining maximum speed at approximately 1,500 ft. higher altitude, using about 100 gal. less gasoline for each 600 miles and affording the use of lighter engines. *Flying and Popular Aviation*, July, 1942, pages 42, 106, 2 illus.




*Official photograph U.S. Army Air Corps.*

Henschel Hs 123.

## Gliding and Soaring

**Sailplane Manufacturers Anticipating Vast Expansion for War and Post War.** The possible scope of the military glider program is commented upon. Brief mention is made of the contracts that are presumed to have been given for gliders to be used in training work and also as trailers to transport military freight and personnel. *American Aviation*, June 1, 1942, page 3.

**U.S.A.: Gliders.** Some details are given of various types of American gliders and sailplanes reported ordered by the U.S. Army Air Forces and the Naval Air Service. *Interavia*, February 27, 1942, page 15.

**Sailplane Prophecies.** Hawley Bowlus. The military advantages presented by the use of gliders are related by a pioneer gliding pilot, who also gives a short history of soaring in the United States and ventures some predictions as to its potentialities for the future. Economy, silence, maneuverability and consolidation of forces as compared with parachute troops, mobility on the ground, slow landing speeds that permit of landings almost anywhere, towing efficiency and the ability to maintain communication are shown.

The author reveals a suggestion that he made to the Navy Department for the use of gliders in connection with convoys and other ships operating on the high seas. This was to launch gliders on wire controls at frequent intervals to the height of 2,000 or 3,000 ft., a method of observation which he evaluates as inexpensive and efficient. He predicts that one contribution of military experience to commercial advancement after the war will be the use of transport airplanes towing a string of gliders, which will afford passengers a mode of air travel free from vibration, noise and other current inconveniences. *Western Flying*, May, 1942, pages 42, 43, 60, 62, 6 illus.

**Glider Training.** W. J. Jakimiuk, W. Czerwinski, and T. B. S. Tarczynski. Taking the initiative in the development of gliding clubs within the Canadian aircraft manufacturing plants, the Engineering Department of the de Havilland Aircraft Company is building a training glider that will be ready for active use this summer. Specific details are given regarding the performance, structure and design features of this glider which will enable it to conform with requirements for training on flat ground. There is also an explanation covering general training methods, with particular attention given to the initial period. *Canadian Aviation*, May, 1942, pages 30–32, 35, 58, 4 illus.

**Lightplane "Soaring."** Frank H. Buck, Jr. Similar to soaring is the

act of flying a light airplane across mountains, shutting off the engine and depending on thermals to maintain flight. This article explains the nature of the phenomena and tells how to meet the dangers of a "downdraft." *The Sportsman Pilot*, May 15, 1942, pages 10, 11, 1 illus.

**The Gliders Are Coming.** Dr. Alexander Klemin and Frederic Sondern, Jr. The principles of gliding are explained in their relation to military transportation, supply, attack and invasion. The article also includes a discussion of the present program of the Army Air Corps for training glider pilots and plans for the production of gliders on an assembly line basis. *Air Facts*, June, 1942, pages 30–33, 36, 37.

## High-Altitude Flight

**Oxygen Breathing Systems.** A. R. Weyl. Conditions under which a supply of oxygen is necessary for the crews of aircraft are reviewed. The symptoms of lack of sufficient oxygen are analyzed, attention being paid to the effects of an excessive supply. Physiologic and chemical reactions are described. The writer then takes up the principal systems of breathing apparatus, listing the compressed oxygen system, the liquid oxygen system and the chemical respirator system as having several important advantages for aeronautical purposes, which he summarizes under 12 headings. These include safety in war circumstances, life-saving qualities, attachment to the body, easier handling, source of heat, comfortable use, protection against fumes, reliability, mouth or nose breathing, no necessity for gasproofing or ventilating cabins, absence of complicated apparatus, and chest protection. The three methods are compared from the standpoint of weight. Brief consideration is given to other forms of chemical oxygen generators which may be developed, particularly an open type eliminating the use of tight-fitting masks. *Aircraft Engineering*, April, 1942, pages 92–96, 110, 3 illus.

## History

**Handley Page in History.** The part played by Handley Page in the development of bombers is traced briefly. A tabulation is presented of all of the company's basic types from the one first flown in 1909 to the present. The manufacturer's type designation is shown, along with the Air Ministry's specification to which the prototype of each airplane was designed. The name of each model, type, purpose and date of first flight of prototype are given. *The Aeroplane*, April 24, 1942, page 471.

## Icing

**Air Supply and Icing Production of Aircraft Carburettors.** It is claimed that present induction systems of aircraft carburetors are still far from meeting all requirements in every respect for protection from icing. Adoption of direct fuel injection into individual cylinders is recommended as a solution. *Interavia*, January 31, 1942, pages 1–5, 3 illus.

**U.S.A.: Windshields.** United Air Lines are now reported to be equipping their aircraft with double windscreens with a $^1/_8$-in. airspace between them. Hot air from the cabin heating system is conducted through this space to make the windscreen ice-free. *Interavia*, March 16, 1942, page 12.

## Inspection

**High Sensitivity in Radium Radiography of Castings.** L. W. Ball. It is stated that with suitable exploitation of the emulsion characteristics of *Noscreen* film, radium radiography provides a highly satisfactory method of examining steel castings from $^1/_4$ in. to 6 in. in thickness. The belief that radium as an inspection tool is only useful for great thickness of metal has been shown to be completely without foundation. For all "badly blocked" castings, radium radiography is claimed to be the most suitable method of examination. *ASTM Bulletin*, May, 1942, pages 29–32, 7 illus.

**Training Women Inspectors.** To keep pace with the growing number of women who are being recruited into its ranks, the Aeronautical Inspection Department of Great Britain has a new training scheme for instructing them in the specialized knowledge necessary for aeronautical inspection work. This system of training is governed by three principles—immobility (employment of women workers in their own locality wherever possible), specialization and previous experience—and is separated into two parts, training at an A.I.D. school and training in a factory. The school instruction is devoted to those subjects that are difficult to teach in a plant, but anything that can be taught by practical application is taught at the factory. The preliminary training course and its curriculum, divisional training, the engine divisional course, the equipment and materials course, and other divisional courses are outlined. *Aircraft Production*, May, 1942, pages 370–372, 10 illus.

**Inspecting Bolts, Nuts and Screws.** As in all other aircraft parts, the bolts, nuts and screws must be as nearly perfect as human ingenuity can make them. This article shows the processes and equipment used in inspection of such parts in the plants of the Lamson & Sessions Company. The methods followed in this precision work are described and illustrated, as well as the advanced production and inspection methods used for similar parts for ordinary commercial use where such a high degree of precision is not required. *American Machinist*, May 28, 1942, pages 496–499, 12 illus.

## Instruments

**The Space-Time Recorder.** F. N. M. Brown. Several types of recorders for drop testing of landing-gear combinations are described. Three of these recorders depend on mechanical linkages for the transmission of the space element from the falling mass to the record paper. Only the first of these is able to record the rebound phenomenon. A fourth recorder determines loads directly by means of a magnetic strain gauge within a dynamometer ring mounted between the main sprung mass and the upper part of the strut. In addition, slide-wire potentiometers are arranged between the upper and lower parts of the strut and between the wheel and the jig. All three quantities—i.e., deflection of the ring, relative motion between the two parts of the strut, and the deflection of the tire—are then represented on the photosensitive element of an oscillograph. A considerable sacrifice of simplicity and the introduction of highly sensitive and necessarily delicate instruments are the only drawbacks mentioned as the price to be paid. The writer summarizes his preference for the photographic type of recorder for three reasons, including ready applicability under all usual conditions, timesaving factors in operation, and accuracy at least equal to that of any other type. *Journal of the Aeronautical Sciences*, June, 1942, pages 290–292.

**Black-Lighting Plane Cockpits.** Application of fluorescent instrument dials and numerals, activated by ultraviolet radiation or "black light," has been found helpful for the pilots of fighting aircraft, to replace the light from ordinary instrument lamps. It is shown that this type of illumination makes it easier for the pilot to read flight instruments at a glance because it does not entail the adjustment of the eye for the change from dark to light. A small 4-watt lamp inserted in a cylindrical tube fur-

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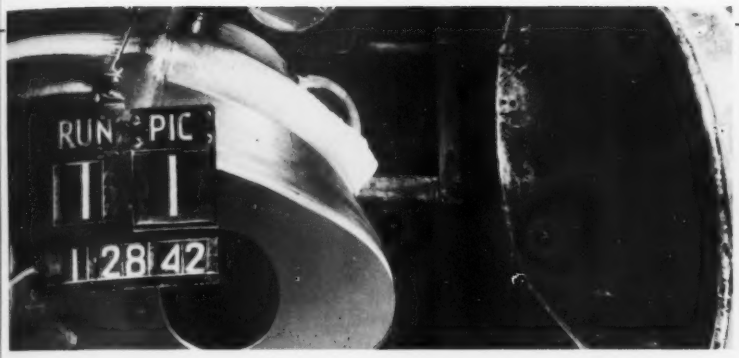
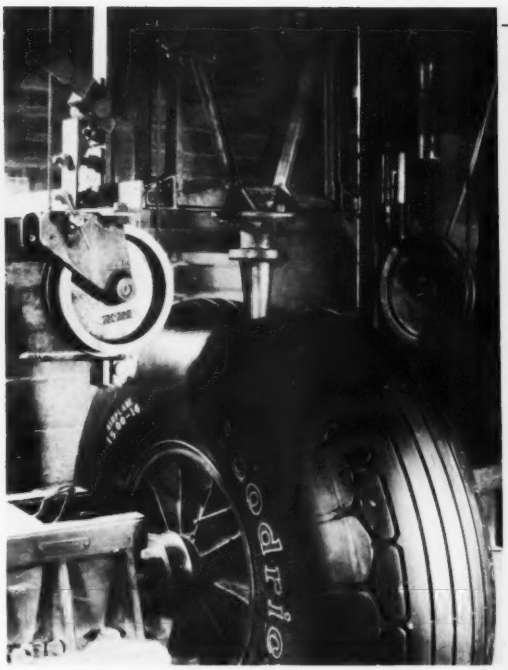



**DRIVING BLIZZARDS MADE TO ORDER!** That's how the B. F. Goodrich Laboratories produce severe flight hazards to test B. F. Goodrich De-Icers. Zero winds rush through this huge wind tunnel. But the pulsating action of the De-Icers attached to the leading edge of the test wing breaks the ice right off!



**CONDEMNED TO THE GUILLOTINE!** That's the fate of this B. F. Goodrich Airplane Silvertown—the famous low-pressure tire used by leading commercial airlines, private and service plane manufacturers. With lightning speed, the plunger drops down a 96-ft. shaft . . . delivers a blow that would mean death to ordinary tires. But B. F. Goodrich Tires can take it!

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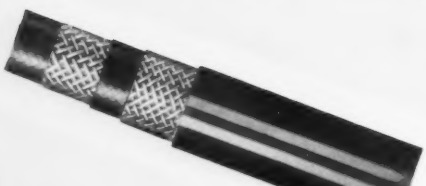

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nishes the ultraviolet radiation. The method of installation is described and the instruments are illustrated. *Popular Science*, July, 1942, page 115, 3 illus.

**Manometers for Routine Testing.** R. Barrington Brock. Attention is called to the lack of care often shown in the selection of manometers for routine testing and the importance of proper design to avoid difficulties and delays in repair and replacement and to insure adequate protection against damage. Advantage of the U tube, effect of capillarity, choice of liquid, causes of breakage, special types for low pressure and effect on angular inclination are among matters discussed. *Aircraft Engineering*, April, 1942, pages 104, 105, 110, 3 illus.

**Plotting the Course.** For teaching celestial navigation, Link Aviation Devices, Inc., has developed a new bubble sextant incorporating two ingenious applications of plastics. Urea-formaldehyde is molded to form the recording drum. An electric bulb inside the sextant throws enough light through to make pencil marks discernible on the detachable drum. The clear plastic has the unusual property of carrying light around curves. Use of methyl methacrylate is said to simplify the design, make it more compact and reduce weight. *Modern Plastics*, May, 1942, page 39, 3 illus.

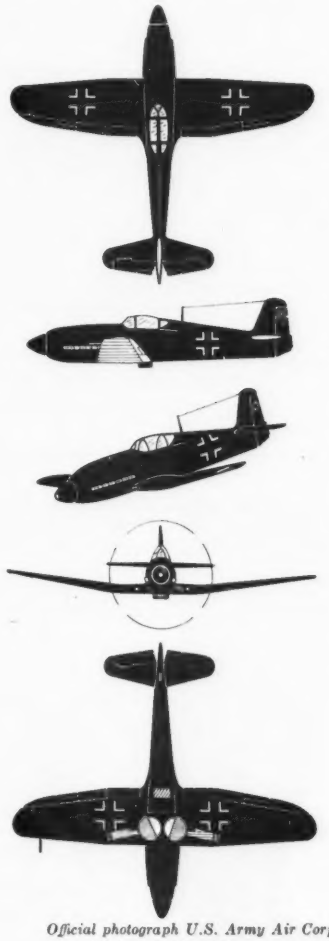
## Jet Propulsion

**Thermal-Air Jet-Propulsion.** Gohlke. Reprinted from the February, 1942, issue of *The Aircraft Engineer* this article occupies an entire number and presents a comprehensive summary of existing patents dealing with jet propulsion, beginning with a patent taken out in 1909 by Marconnet in France. The principles of operation are set forth briefly and numerous drawings are reproduced to illustrate the text. *Astronautics*, May, 1942, pages 3–16, 68 illus.

**New Ideas on Propulsion.** With short descriptions of the designs considered, comment is made on some French and American projects for jet-propelled aircraft. Incorporating this principle is the experimental airplane designed by R. Leduc now being built by the Bréguet Aircraft Works at Toulouse. It is said to be basically similar to the Italian Caproni-Campini but to employ a steam turbine instead of a standard type of air-cooled radial engine to drive the air compressor unit. The American projects discussed are the four different arrangements of power units patented in the names of Igor I. Sikorsky, M. E. Gluhareff, and R. W. Griswold and assigned to the United Aircraft Corporation. The declared objects of these are to conserve engine power by the utilization of waste heat, to improve engine cooling, and to enhance the aerodynamic characteristics of the wing section. *Flight*, April 30, 1942, pages 422, 423, 3 illus.; *Interavia*, January 22, 1942, page 10.

## Landing Gear

**Graphic Analysis of Tripod Landing Gears.** Seymour Arkawy. The writer states that graphic analysis



*Official photograph U.S. Army Air Corps.*
Heinkel He 113.

of a three-dimensional structure may be done by the use of descriptive geometry and the principles of plane structures. Several advantages of the graphic solution are given, such as the speed with which it can be done and the smaller possibility of error. The accuracy of this form of solution, it is claimed, is as good as that of the analytic solution. The article deals with the steps to be taken for the graphic analysis of tripod landing gears. *Aero Digest*, June, 1942, pages 157, 158, 314.

## Lighter-Than-Air

**Sky-Scow.** Paul Schubert. Operations of the Navy's dirigible patrol along the Atlantic coast and over other coastal waters are the subject of this narrative. The airships used are described, as well as the services they perform and the problems encountered in their flying routine. This branch of the service works closely with the ships of the Navy and Coast Guard and with Army aircraft in combating the submarines and in rescue work. *Colliers*, May 23, 1942, pages 64, 65, 67, 2 illus.

## Lubrication

**The Nature of Static Friction.** Walter Claypoole and Donald B. Cook. Various factors concerned in friction form the subject of this discussion, with emphasis on the mechanism of the phenomena static friction. The limitations of the several approaches heretofore used are reviewed and the opinion is expressed that friction can be accounted for only by a varying combination of a large number of factors instead of any one factor. First, there is a discussion of the probable behavior of simple hypothetic systems having ideal surfaces, for which all conditions are rigorously specified, in an effort to develop a more satisfactory view of the basic cause of static friction in relation to modern experimental knowledge. This is followed by a discussion of the behavior of less ideal systems in an attempt to determine what changes may be expected when specified departures from the ideal conditions occur, thus relating the earlier discussion to conditions in the best obtainable practical situation. *Journal of The Franklin Institute*, May, 1942, pages 453–463, 5 illus.

**Changes Occurring in Oils and Engines from Use.** Frank A. Suess, W. A. Jones, H. C. Baldwin, and Robert E. Lincoln. This paper was prepared following the presentation of a paper by B. E. Sibley at the S.A.E. meeting of June 5, 1941, in which operating temperature data on a fleet of road-test units were given. The paper reviewed herewith describes the changes occurring in five oils used in that test and the nature and amount of deposits left by the oils in the engines. The results of these tests are given in tabular form. The five oils are rated in the order of descending merit by the oxygen-absorption test, modified Underwood test, mechanical laboratory engine and road-test units. This series of tests is held to indicate the necessity for a variety of oil-testing equipment and the futility of anticipating the de-

velopment of a single piece of equipment that will quickly and correctly evaluate lubricating oils. *S.A.E. Journal*, May, 1942, pages 196–208, 4 illus.

**Engine Guardian.** J. F. Flaherty. Details of an oil dilution system for overcoming the problem of frozen oil and cold engines. Gasoline from the fuel line is injected into the oil prior to stopping an aircraft engine, causing the thinning of the oil by the gasoline so that it does not congeal. The engine can then be started in subzero weather without the application of external heat. Since the gasoline in the oil is evaporated by the heat of the engine, the oil is then restored to its original condition. *Flying and Popular Aviation*, July, 1942, pages 40, 105, 106, 2 illus.

## Maintenance

**Service Problems of Aircraft Engine Exhaust Systems.** Jack C. Zippwald. Discussion of service problems of slip-joint collectors, collector collars, and ball-and-socket collectors. Collector-ring body sections are subject to cracking at port inlets, wear at the section joints and burning. Suggestions for servicing the manifold are given. *Aviation*, June, 1942, pages 175–180, 9 illus.

**Maintenance Command.** J. C. Trewin. The history and function of the Maintenance Command of the Royal Air Force, which was created four years ago under the direction of Air Marshal John Stanley Travers Bradley. This organization handles the task of keeping the R.A.F.'s flying stock in fighting shape and providing the three-quarters of a million different items required for the efficiency of the aircraft and the comfort of the personnel. Salvage and supply are among the problems that confront this command, and the solution to some of these are presented. *Aeronautics*, May, 1942, pages 40, 41.

**Maintenance Prevents Accidents.** W. E. Koneczny. From statistics gathered by the Civil Aeronautics Board Safety Bureau, insufficient maintenance procedure is indicted as the reason for a majority of non-air-line airplane accidents aside from those caused by power-plant failure. This article surveys the parts of the airplane which appear to be responsible for most of the difficulties and offers advice on how to reduce the likelihood of accident. The control system, wings and control surfaces, landing gear and several miscellaneous components are listed as those parts requiring special maintenance attention. *Southern Flight*, May, 1942, pages 13, 14.

**Bottlenecks of Vital Information.** "Watchkeeper." Complaints are expressed against the way the manufacturers of aircraft and parts for the Royal Air Force put certain parts under seal, indicating that repairs or adjustments of such parts must not be attempted in service stations or in the field but should be returned intact to the makers. It is contended that this is impractical in many instances and impossible when the aircraft are used in foreign lands and that this tends to foster an attitude of negligence on the part of mechanics who feel that they should not be expected to learn the functions of parts that the builders make so inaccessible. When such accurately made or sensitively adjusted parts are employed, the writer feels that complete instructions should be given so that service personnel may be as competent to repair and adjust them as any other part of the aircraft. Another cause for criticism is the tendency of manufacturers to rely upon civilian mechanics for such work in the field. *The Aeroplane*, April 10, 1942, page 410, 2 illus.

**Helping to Keep R.A.F. Fighters in Action.** Photographs with descriptive captions show some of the operations entailed in the maintenance of Royal Air Force fighting aircraft. It is shown that to a large extent women are taking the place of men as main-

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tenance mechanics. *Automotive and Aviation Industries*, May 15, 1942, pages 28, 29, 5 illus.

## Management

**Incentives and Production.** Gordon H. G. Garbett. Propaganda alone as a method for increasing aircraft production has not been successful, according to this writer. Standard incentive systems for lifting production quotas, such as the Halsey Plan and the Rowan Gantt, Harrington Emerson, Taylor and Beddeaux systems are explained and applied to the task of increasing airplane and military material output. *Aeronautics*, May, 1942, pages 46–49.

**A Forum on Aviation Management.** Alexander Klemin. A brief report on the Forum on Aviation Management held under the auspices of the American Society of Mechanical Engineers on December 3, 1941. Speakers representing many fields of aeronautical manufacturing met and discussed the complex problems of sudden expansion and their solutions. Discussions are analyzed, facts and views being grouped under different aspects of modern management. *Mechanical Engineering*, June, 1942, pages 479, 480.

## Materials

**Germany/Rumania: Synthetic Rubber.** It is reported that negotiations between German and Rumanian rubber concerns will result in a production of 3,000 tons of synthetic rubber annually. Transylvanian natural gas resources will be utilized. *Interavia*, February 27, 1942, page 11.

**New Material.** The British firm of Pytram Ltd. has developed a fibrous synthetic construction material of about $^1/_8$-in. wall thickness. Consisting of cellulose-fiber laminations impregnated with a special bonding material, it is said to be suitable for ducts, intakes, fairings, tubes, etc. *Interavia*, January 14, 1942, page 12.

**Rust Prevention.** E. E. Halls. Evaluating the advantages of lanolin compounds for the protection of ferrous materials from rust, this is an explanation of the compound's characteristics, functions, essential properties and applications. The observations are pointed toward the conclusion that lanolin-base protection is definitely superior to that of mineral oil.

A series of tables present a variety of data on the subject. Table 1 gives the characteristics of lanolins used as basis of rust preventers; Table 2, the characteristics of proprietary lanolin-base rust preventers in mineral oil or jelly solution. The characteristics of proprietary lanolin-base rust preventers in volatile solvent solution are presented in Table 3; characteristics of emulsion-oil type of rust preventers in Table 4. Table 5 contains information on the characteristics of mineral oil and jellies, representing those used for rust prevention and used in comparative tests; Table 6, the exposure test results on mild steel coated with various preventers. *Aircraft Production*, May, 1942, pages 355–357.

**Wooden Ships Return.** Otto Timm. The president of Timm Aircraft Corporation recounts some of the developments that have taken place in the use of plastic-bonded wood for airplanes and lists its advantages as an aircraft production material. He states that it can be abundantly supplied, is more resistant to fire than either magnesium or aluminum, is corrosion resistant and suitable for use by hundreds of thousands of woodworkers not now assimilated into the war industries and will be possible to manufacture with machinery and plant facilities already in existence. Making immediately available a tremendous additional production capacity by the conversion of furniture factories and the like, it is his contention that wooden airplanes offer the best means of expediting aircraft production because they solve a threefold problem: lack of strategic metals, lack of plant capacity and metal working machinery, and lack of skilled metal workers. *Western Flying*, May, 1942, pages 26, 27, 66, 5 illus.

*Official photograph U.S. Army Air Corps.*

Messerschmitt Me 109F-1.

## Medicine

**The Physical Maintenance of the Pilot.** Arnold D. Tuttle. A study is presented by the medical director of United Air Lines on the methods used in the selection and maintenance of pilots from the physical standpoint. The rigid physical and mental standards required for successful air-line pilots are set forth and details are given on the examinations that must be undergone by candidates prior to employment, as well as the periodical examinations that are necessary to guard against the failure of the human element in the operation of air lines. Physiologic and psychologic characteristics of air-line pilots are surveyed. The relationship between these characteristics for pilots in commercial aviation and for military aviation is set forth, as well as the additional steps that must be taken to maintain the fitness and efficiency of military pilots. *New International Clinics*, Vol. I, Series 5, pages 47–60.

**The Enlisted Assistant to the Flight Surgeon.** Capt. Paul W. Holmes. The School of Aviation Medicine now conducts a course for enlisted assistants. The course is of six weeks' duration and covers approximately 250 hours of instruction in the administrative and clerical work of a flight surgeon's office. Army Regulations grant the assistant a third-class specialist rating. *The Military Surgeon*, June, 1942, pages 675–678.

**Relation Between the Electroencephalogram and Flying Ability.** Melvin Thorner, Frederic A. Gibbs, and Erna L. Gibbs. To determine whether or not correlations exist between flying ability and the electroencephalogram (an indicator of cortical function of the brain), a group of 109 aviators, of whom half were cadets and the other half experienced pilots, has been studied. The investigation showed that flying ability can be correlated with: (1) distribution of energy in the right occipital spectrum; (2) the dominant frequency and character of the electroencephalogram or ink record; and (3) the amount of slowing that occurs from overventilation. Too few cases were studied to allow determination of an exact predictive value, but the data suggest that if correct criteria are

used it may be possible to select a superior group of candidates for flying instruction, thereby reducing the number of failures. It is said to be unlikely that an electroencephalogram examination will be used by the Air Corps in the immediate future. *War Medicine*, March, 1942, pages 255–262, 2 illus.

**Psychiatric Problems in Military Aviation.** R. Barry Bigelow. Psychiatric problems in military aviation are classed under three headings: selection, training and maintenance. Under the heading of selection it is stated that there is need for improving the psychologic evaluation of candidates, and some of the difficulties involved are discussed. The article reviews past and present work and describes problems requiring further study. Various methods for selection are recommended, such as questionnaires, intelligence tests, interviews and others including the psychomotor coordination tests.

The incidence and types of psychiatric deviations during flight training are discussed under the heading of training. It is stated that there is need for further work in collecting and analyzing case histories. Suggestions are made indicating means whereby a medical officer can aid those in charge of flight training and instructor training. The incidence and types of psychiatric deviations occurring in flying and nonflying personnel are taken up under the heading of maintenance. Suggestions are made with regard to the role of the flight surgeon. *War Medicine*, May, 1942, pages 381–402.

## Metallurgy

**Powder Metallurgy of Tin.** H. C. Watkins. A compilation of published information on the entire field of powder metallurgy as related to tin and tin alloy powder. It is noted that the art has a much broader application than those involved in fabricating operations only and serves a field that is much more extensive than the manufacture of useful articles by pressing and sintering metal powder. The science of powder metallurgy includes the production of powders and their applications in many ways. Methods of manufacture of tin powder and of tin-alloy powders are described. A bibliography is appended as well as a list of patent literature. *Metals and Alloys*, May, 1942, pages 751–757, 4 illus.

**Replacing Tungsten.** In an anticipated shortage of imported tungsten and nickel, research in the United States was instituted to evolve a substitute alloy. The successful use of molybdenum in tool steel and alloys for highly stressed parts is said to point the way to relieving American industry from dependence upon uncertain imports of large quantities of tungsten and nickel from foreign sources. *Aircraft Production*, May, 1942, page 342.

**Practical Advice and Working Data on Construction of Small Aircraft Parts.** A. Dickason. Advice is given on the construction of small parts of light aluminum alloys. Methods of preparation, strengthening and joining these parts are discussed. *Sheet Metal Industries*, May, 1942, pages 637–647, 19 illus.

**Forging Aluminum Alloys.** Herbert Chase. In this first article of a series on the forging of aluminum alloys, the writer explains how the forging methods for aluminum differ from those for steel. In some instances they are similar, especially when using forging dies on steam and board hammers. Furnaces also can be similar, though a lower temperature is required for aluminum. The technique differs in many details. These are discussed at some length. *American Machinist*, May 28, 1942, pages 491–493, 5 illus.

## Meteorology

**Periodicity and Symmetry in the Course of Atmospheric Pressure and Their Importance for Weather Forecasting.** Karl Stumpff. This paper states that long-term weather forecasting is based on statistics. Periodicity and symmetry methods are described. It is concluded that the periodic method by itself has little chance of success, but when taken in conjunction with symmetry research it will represent a useful contribution. *Bulletin of the American Meteorological Society*, March, 1942, pages 105–110, 3 illus.

**Forecasting Fog.** B. C. Haynes. A brief article defining fog and indicating the importance to flying of fog forecasts. Directions are given for forecasts of one to two hours. *Flying and Popular Aviation*, July, 1942, pages 53, 110, 3 illus.

**La Navegación Aérea a Través de las Nubes La Formacion de Hielo (Flying Through Clouds).** The second installment of this meteorologic study is devoted to culmulus-nimbus clouds. The writer divides them into three types, designated as tower-shaped, shaped like an inverted anvil, and shaped like an inverted bell. The characteristics of these cloud shapes are presented, special consideration being given to horizontal extension, internal visibility, internal intensity of light, internal turbulence, internal ascending currents and internal precipitations. The effects of these characteristics on air navigation are studied.

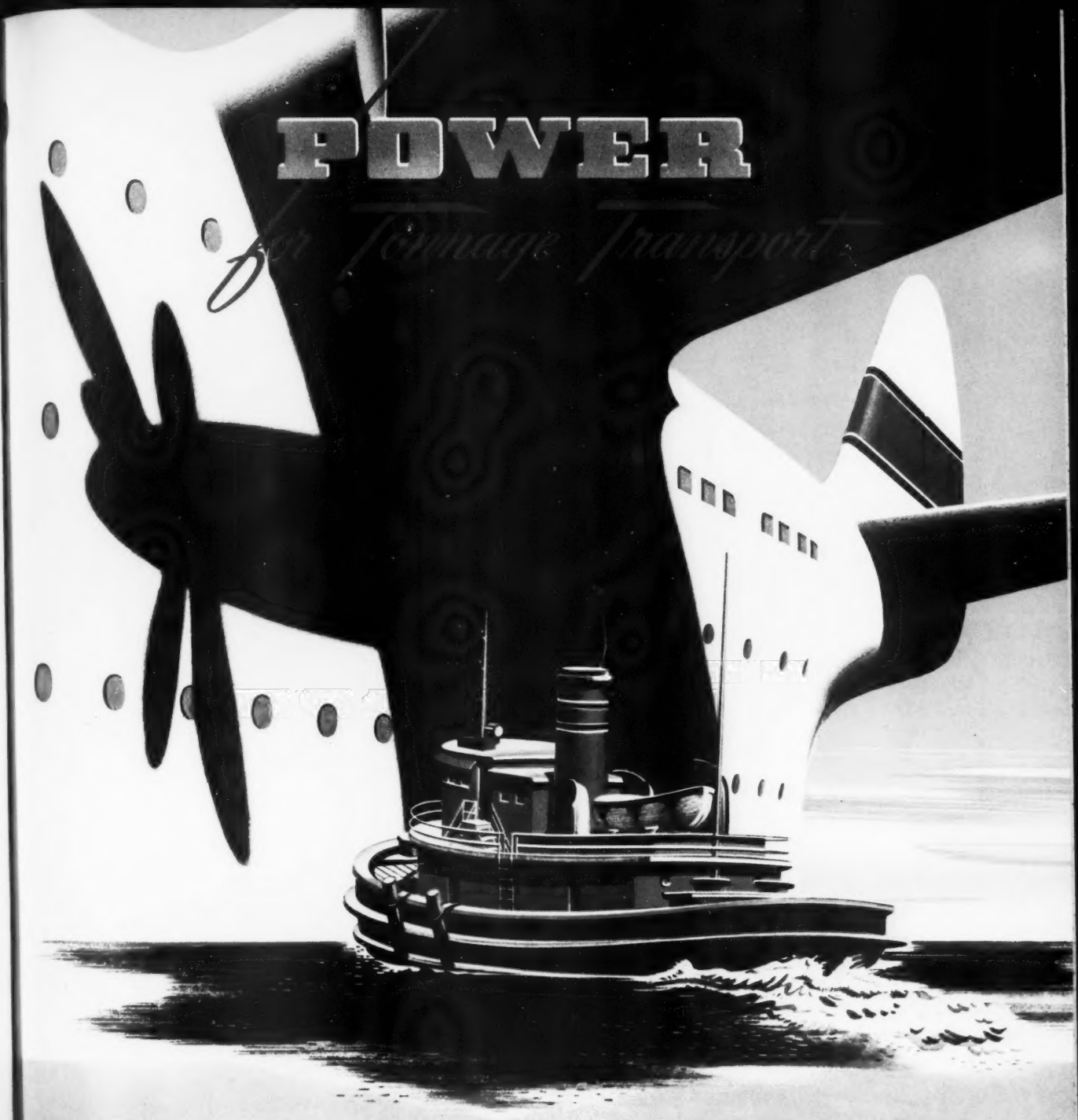
The final installment of this article deals with nimbus clouds, giving their characteristics. The relations between these characteristics and ice formation, also the characteristics of ice formation in nimbus clouds, are explained. The writer suggests plotting a detour route to avoid these clouds, even if it should necessitate a considerable loss of time in reaching the destination. This suggestion includes the selection of the proper flight altitude according to the rate of climb. For landing, a proper point should be selected from which to start the glide, and proper directions should be followed to bring the airplane through the clouds toward the ground. Furthermore, precautions are suggested in case of ice formation during climb, during straight flight and during loss of altitude while gliding. *Avia*, February, 1942, pages 43–46, 4 illus.; March, 1942, pages 81–89.

# Military Aviation

**Aircraft and Torpedo.** The conclusion of an article on the torpedo bomber. Brief descriptions of existing types used by the belligerent nations are included. *Interavia*, December 20, 1941, pages 1–4, 7 illus.

**Bomber Ferries Play Thrilling Part in Carrying War to Enemy.** Major Frank L. Nelson. Activities of the Flight Training Section of the Army Ferry Command are described in this article, which tells how special training is given to experienced pilots with the duty of delivering new aircraft from the factories to the fighting fronts. *U.S. Air Services*, May, 1942, pages 19, 20, 1 illus.

**Those Mysterious Dive-Bombers.** F. C. Sheffield. This plea for greater inclusion of dive bombers in Great Britain's military aviation strategy states that prejudice against them has been too inflexible. Although admitting that dive bombers are specialized weapons, it tells of their advantages and compares them with other types of military airplanes. The principles of dive-bombing technique are explained. Part of the article is devoted to a discussion of the effect Great Britain's lack of dive bombers had upon the escape of the German warships, "Scharnhorst," "Gneisenau" and "Prinz Eugen"

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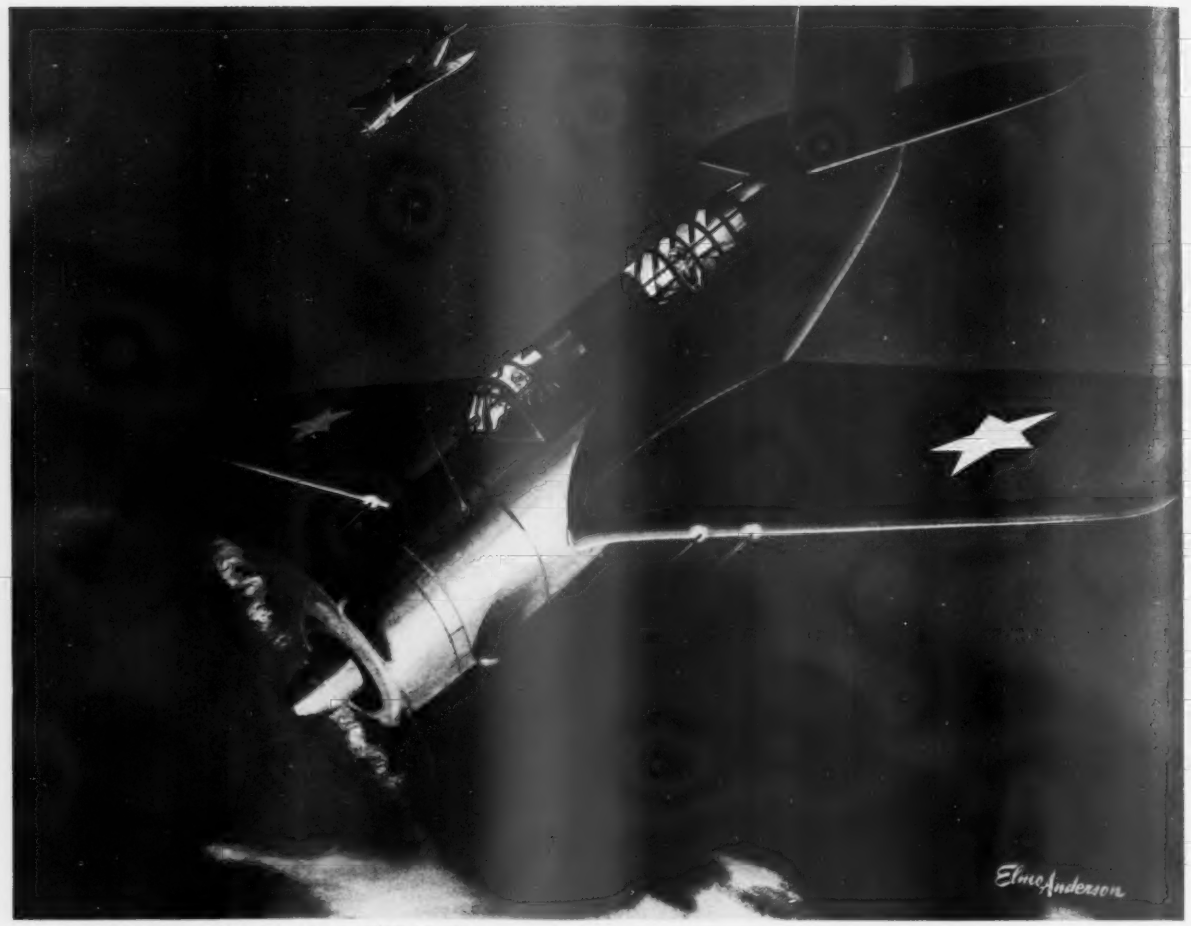


*Curtiss dive bomber SB2C-1 fabricated with Boots Self-Locking Nuts.*

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through the Straits of Dover. *Flight*, April 30, 1942, pages 425–429, 11 illus.

**U.S.A.: A.A. Guns.** Prior to the entrance of the United States into the war, it is stated that there was a lack of antiaircraft guns. As far as can be ascertained the following types of guns will be supplied to American defense forces: 50-caliber machine guns; 20-mm. Oerlikon automatic guns; 37-mm. automatic aircraft guns, a type used on fighter aircraft and for antitank work; 40-mm. Bofors; a new 90-mm. gun firing a 21-lb. shell; a new 4.7-in. antiaircraft gun with a range in excess of 30,000 ft.; and a 5-in. naval gun. *Interavia*, March 28, 1942, pages 17, 18.

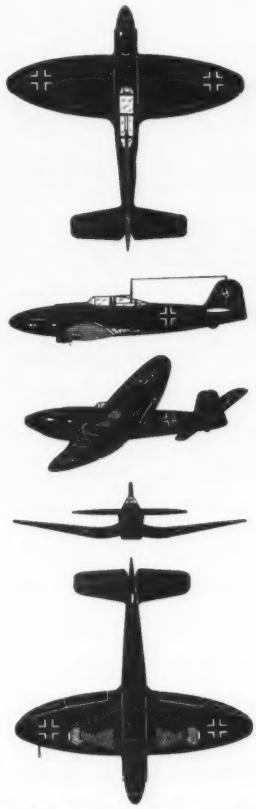
**Famosa aviao Norte-Americano com a R.A.F. no Oriente-Medio (Famous North American Aeroplane with R.A.F. in the Middle East).** Brief historical notes on the development of the Tomahawk for the Curtiss P-36. Most of these aircraft delivered to date are for the home defense of the British Isles and for use in the Middle East against invasion so as to relieve the British factories from the production of aircraft for colonial combat and reserve the Hurricanes.

The Tomahawk squadrons form the backbone of the pursuit squadrons of the R.A.F. in Egypt and were efficiently employed in the first "British Blitzkrieg" of December, 1940, in Libya for actual offensive work. Accompanying troops at ground level and machine gunning the enemy or protecting the R.A.F. bombers in the defense of Tobruk, they played an important role with great success. This is their history, as related in this article.

The development of the Tomahawk is traced and information is given on how the British planned to improve its speed and armament. Comparisons are made between the Tomahawk as used by the R.A.F. and the Curtiss P-40 of the U.S. Army Air Corps in the matter of dimensions, power plant, armament, horizontal and climbing speed, and the fire power of their armament.

It is reported that the Tomahawks are carried by sea to Freetown where they are mounted and, after a brief checkup and test, the machines are flown across the continent to Egypt. For this purpose Curtiss-Wright has constructed about twenty landing fields across the desert, with lighting, beacons and radio, so that the pilots can make the crossing rapidly. It is stated in the article that by this means an airplane built in the United States is placed in the combat squadrons in about 25 days. *Asas*, February, 1942, pages 25, 26, 3 illus.

**The Adaptation of Light Aircraft to Military Requirements in Time of War.** William A. Hunter. The light airplane has been practically tested by the American armed forces on maneuvers and has proved to be of value for many purposes. It is estimated that some 3,000 new and used light aircraft are lying idle in the United States and that the American aircraft industry is capable of producing 22,000 to 30,000 a year. A plea is made to keep this industry in operation. The writer seeks to prove that reasons against their production, such as the use of vital materials that could be used for first-line aircraft, and the employment of skilled labor that could be diverted to work on heavier types of aircraft, are not substantiated, since little of vital materials are required and semiskilled, and even unskilled, labor can be employed. *Commercial Aviation and Aircraft Production*, May, 1942, pages 96, 98, 5 illus.



*Official photograph U.S. Army Air Corps.*
Heinkel He 112.

**Winged Caravan.** Robert McLarren. The accomplishments of the Army Ferry Command are lauded in this article, which details the important tasks of delivering aircraft and supplies from the United States to remote parts of the world. Operations are traced from the plants of the manufacturers to assembly bases in Florida, to Brazil, across the Atlantic to west African ports, across Africa to Egypt, India and Australia. Some of the problems solved and the difficulties encountered are described. *Model Airplane News*, July, 1942, pages 6, 7, 46–49, 8 illus.; "Air Line to Everywhere" by Denver Lindley, *Collier's*, May 30, 1942, pages 18, 19, 54, 55, 8 illus.

**When the Flying Wing Comes.** James L. H. Peck. A large drawing and brief text depicting an envisaged adaptation of the Northrop Flying Wing as a fighting airplane of the future. Some of the advantages of this type of construction for military aviation are discussed. *Air Trails*, July, 1942, pages 16, 17, 1 illus.

**The Anti-Tank Armament of the Fighter Aeroplane.** Camille Rougeron. Armament problems and tactics for what are termed "tank-busting" operations are discussed. The conclusion indicates that fighting conditions between two airplanes or between an airplane and a tank call for two different weapons even in the case of identical muzzle energy of the projectiles employed. Fighters or attack bombers can be used, and either bombs or projectiles from large-caliber aircraft cannon are effective against tanks or other armored vehicles. Lessons are drawn from the Spanish War, the War in Poland and more recent conflicts. *Interavia*, March 16, 1942, pages 1–4.

**Flight Strip Construction Started, War Dept. Reports.** Photographs, said to be the first released by the Army Air Forces, are reproduced along with the announcement that construction of the first of the proposed flight strips has been started. Estimates of the cost of construction are included. *American Aviation*, May 15, 1942, page 9, 3 illus.

**The Effect of High Speed Dive on the Aircraft Power Plant.** Translated by L. J. Baker from *Luftwissen* for August, 1941, this paper analyzes the strains imposed by a high-speed dive on the various parts of the power plant of an airplane. Problems resulting from overspeeding the engine caused by the "windmilling" action of the propeller are explored and remedies are described. Among the latter are variable-pitch airscrews, the advantages and disadvantages of which are discussed, as well as diving brakes and other devices. Effects on the cooling, fuel and lubrication systems are studied, along with the problems arising in the induction system. Products of the Junkers company are used as examples, that firm being producers of a complete line of aircraft, engines, air-

IT MAY LOOK LIKE A *Gadget*

BUT IT MEANS FASTER, SAFER WIRING . . .

Start spring clip from large terminal by lifting out and upward.

Repeat this operation on the other lip of the small spring clip.

Remove spring clip, give large terminal a quarter-turn. Lift out for soldering as shown at top.

The removable large terminal shown here on the Type K Straight Cord Connector is a patented Cannon feature which applies to both Types K and AN.

It permits the removal of large terminals so that wires may be soldered either by the torch or solder-pot method. Since the greater heat required to solder the heavier connections might melt adjacent ones or burn the insulation, the removable terminal provides a distinct advantage not only in convenience but in time-saving and safety.

This is a typical example of the care which Cannon Engineers give to the small details—details that make a tremendous difference in the finished product.

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LOS ANGELES, CALIFORNIA


screws and auxiliary equipment such as control and induction gear. *The Journal of the Royal Aeronautical Society*, April, 1942, pages 93–106, 9 illus.

**Builders of Air Power.** Outline of the functions of the Air Council, which has been called the board of directors for the Royal Canadian Air Force. It is charged with the administration of the Air Training Plan, aerial home defense and the direction of Royal Canadian Air Force squadrons overseas. The five jobs of the air council which provide for a fighting air force are: getting, organizing, equipping, training, and putting men into action. Under this concentration of responsibility all activities of the R.C.A.F., including the selection and purchase of aircraft, can be related to each other and to the broad Empire plan. Titles of the members of the Air Council are: Minister of Defense for Air, Deputy Minister, Chief of Air Staff, Deputy Chief of Air Staff, Member for Training, Member for Personnel, Director of Recruiting, Member for Air Staff, Member for Accounts and Finance, Member for Organization, Member for Aeronautical Training, Member for Supply. Photographs of the present members are presented. *Canadian Aviation*, May, 1942, pages 26, 27, 70, 12 illus.

## Naval Aviation

**H. M. S. Illustrious.** Photographs of this large British aircraft carrier which has been recommissioned and on active service after repairs and refitting in United States and British dockyards. Views are shown of the flight deck and some of the airplanes, including the Grumman Martlet and Fairey Swordfish. A novel method of hauling airplanes on the flight deck involves the use of small three-wheeled cars made in the United States. *The Aeroplane*, May 1, 1942, pages 496, 497, 11 illus.

**On Seadromes.** C. G. Grey. Seadromes are defined and their merits are discussed. Reasons for their seaworthiness are set forth and comparisons are made with aircraft carriers. Questions are brought up concerning which branches of the armed forces would have jurisdiction over their operation and maintenance. The strategic and tactical uses of seadromes are held to have been proved. Consideration is also given to the factors of destructibility and productibility, the writer expressing the opinion that a seadrome would not be vulnerable to bombs or torpedoes but could be damaged by shell fire from a battleship. It is stated that they can be readily constructed.

Risks in the operation of seadromes are compared with the loss of the aircraft carriers that have been destroyed and the strategy of seadromes is defined. Mobility is another factor that is given consideration. *The Aeroplane*, May 1, 1942, pages 494, 495, 2 illus.

**Aircraft Carriers in the Atlantic War Arena. Part II.** Gordon A. Reeves. This second part of a survey of the carrier strength of the belligerent powers covers details of the individual aircraft carriers of Great Britain and of Germany. *Canadian Aviation*, May, 1942, pages 28, 29, 68, 2 illus.

**Carrier Flight No. One.** William Flynn. A detailed account of the first complete airplane take-off and landing, from the cruiser "Pennsylvania," at San Francisco on January 18, 1911. Made by Eugene Ely, it proved the feasibility of airplane carriers and marked the trend of influence airplanes would have upon naval operations. *Air Facts*, June, 1942, pages 22–28, 2 illus.

**Floating Airfields.** Some facts and figures on American and Japanese aircraft carriers. The types of aircraft employed on United States carriers and their duties are briefly described. *Canadian Air Cadet*, May, 1942, pages 16, 17, 7 illus.

## Parachutes

**Optimum Time of Delay for Parachute Opening.** W. A. Wildhack. The opening of a parachute subjects the parachutist to sudden accelerations, varying as to their peak magnitudes approximately with the square of the speed. The peak accelerations for an air speed of 120 m.p.h. at the time of opening are 4–6*g*—uncomfortable for the parachutist but supportable both by him and the parachute. Openings at excessively high speeds may result in shocks of such magnitude as to cause immediate injury or tearing of the parachute.

It is shown that for any (horizontal) launching speed the velocity of a parachutist falling with parachute closed will pass through a minimum—less than either the launching speed or the terminal speed. The time between launching and the occurrence of the minimum speed is clearly the optimum time of delay for opening the parachute with as little shock as possible.

Formulas are derived relating the magnitude of the minimal velocity to that of the launching velocity and to the angle of the trajectory at which the minimum occurs. The time interval between the launching and the occurrence of the minimum speed is determined from step-to-step computations for various launching velocities.

Charts are given for graphic determinations of the optimum time of delay, the velocity and the distance fallen at any time before opening for various launching velocities.

The formulas and charts are derived in general form, making them equally applicable to problems of landing material as well as personnel by parachute, given only the terminal velocity (or the mass and the drag at a given air speed). As one example, values obtained for an average parachutist (terminal velocity 160 ft. per second), launched with a horizontal velocity of 160 ft. per second, indicate that a minimum speed of 125 ft. per second will be reached after 2.8 sec. when the direction of falling makes an angle of 35 deg. with the horizontal and the vertical distance fallen is about 120 ft. The opening shock for the optimum delay would be approximately $(125/160)^2$ or 61 per cent of what it would be for immediate opening or for opening delayed more than 12 sec. Even for a launching velocity of 500 ft. per second, the opening shock may be reduced to 80 per cent of the value for terminal velocity by opening the parachute at the proper time—after 7 sec. for the average parachutist.

It is shown that the effect of altitude is to lengthen the optimum time of delay for a given indicated air speed at launching, the sea-level value having to be multiplied by the square root of the density ratio. *Journal of the Aeronautical Sciences*, June, 1942, pages 293–301, 7 illus.

## Personnel

**The R.A.F. Works Services.** Maj. F. A. de V. Robertson. The organization and duties of the Royal Air Force Works Services are outlined. Operated under the direction of the Air Ministry Works Directorate, the R.A.F.W.S. forms an on-the-spot civil engineering emergency reserve. Men with civilian building-trade experience form the main body of this service. The trades it recognizes are: carpenter, bricklayer, plumber, works electrician, steel erector, concrete worker, drain layer, groundsman, blacksmith and plant-operator. *Flight*, May 7, 1942, pages 452, 452a, 452b, 8 illus.

**Ten Airline Jobs for the Beginner in Aviation.** Kinds of work open to beginners in the field of air transport are explained. The requirements, duties, pay and opportunities for advancement in ten different positions are shown, some of which are in the shop and others in the office. *Air News*, June, 1942, pages 26, 27, 12 illus.

**Money Fighters.** Charles Kennett. The activities of professional combat pilots who serve nations other than their own for pay and adventure are discussed. Experiences of the writer and others in the first World War and in various parts of the world are drawn upon to show the services rendered by these "soldiers of fortune." *Air News*, June, 1942, pages 10, 11, 29, 10 illus.

**Meet the Girls Who Keep 'Em Flying.** Frank J. Taylor. A group of brief word-portraits of women with jobs in aircraft factories. The ages of these women cover a wide range of years, their origins are varied and they are of many types. Individual cases are discussed in the process of considering the numerous types of aircraft work that women are now doing. The quality of their work appears favorably in a comparison with that done by men, and it is affirmed that they have an equal rate of pay. The article also surveys housing, fashion, personnel, and hours problems involved in the employment of women in the aeronautical industry. *The Saturday Evening Post*, May 30, 1942, pages 30, 31, 57, 58, 7 illus.

## Personalities

**Magic From Waterproof.** How Brig. Gen. Claire Lee Chennault proved that fighting qualities can triumph over numerical odds and superior equipment in the hands of the enemy is shown in an account of the operations of the American Volunteer Group in China, Burma and India. Teamwork, drill, strategy and the leadership of this widely experienced flying officer, who was once a schoolmaster in Waterproof, Louisiana, are credited with the successes that have been achieved. *Time*, June 8, 1942, page 30, 1 illus.

**Stanton Goes to the Top.** A biographic sketch is given of Charles I. Stanton, recently named as Administrator of the Civil Aeronautics Administration. *U.S. Air Services*, June, 1942, page 19, 1 illus.

## Photography

**Photo-Copying Methods in the Drawing Office.** The "Statfile" recorder and enlarger is a photocopying installation differing from other machines by producing a copy negative on film, size $6\frac{1}{2}$ in. by $4\frac{3}{4}$ in., rather than on paper. As a result there is no restriction on the size of the original which can be copied. Small negatives provide permanent records of the originals which can be used at any time for blueprints or

***NOCTURNAL PROWL . . .*** the somber silhouette of a mighty Republic *P-47* THUNDERBOLT in the stratosphere portends sudden disaster for Axis planes caught out in the night air. Republic Aviation Corp., Farmingdale, Long Island, New York.

# REPUBLIC AVIATION

REPUBLIC AVIATION

photographic enlargements. Methods of operation are explained. *The Engineer*, May 15, 1942, pages 415, 416, 2 illus.

## Plants

**Germany: Aircraft Industry Expansion.** Mention is made of a number of new plants and of the expansion of existing plants engaged in work for the German aircraft industry. *Interavia*, January 14, 1942, page 13.

**Switzerland: Pilatus Flugzeugwerke.** A new Swiss aircraft company has been founded at Stans. Known as "Pilatus" Flugzeugwerke A.G., it will supplement the State Aircraft Factory at Thoune and the Dornier Works at Altenrhein. *Interavia*, February 10, 1942, page 17.

**Underground Factories.** J. Russell. A description of the writer's visit to one of England's underground aircraft factories. The dimensions are indicated, and equipment, heating, lighting and air conditioning of the subterranean passages are given, as well as general living and working conditions in these plants. *Aeronautics*, May, 1942, pages 42, 43, 2 illus.

**Great Britain: Underground Aircraft Factories.** It has been disclosed that seven underground aircraft factories have been completed or are under construction in England. Quarries and chalk mines are being used as sites. One already in operation has an area of 40,000 sq.ft. A second factory will be completed in August, 1942, and is expected to employ 8,500 in the production of engines. *Interavia*, March 28, 1942, pages 13, 14.

**New Machines at Aeroproducts.** The installation of additional machinery to aid in the production of full-feathering propellers at the Aeroproducts Division of General Motors is depicted and described briefly, supplementing an article in an earlier issue in which the plant was more fully described. *Automotive and Aviation Industries*, June 1, 1942, page 35, 4 illus.

**Plant Protection.** Preparations that should be made for the protection of plants in the event of air raid are set forth. It is suggested that an air-raid protective organization should be built up from the plant personnel, provision made for black-out and precautions taken against flying window glass. Instructions are given for the organization and training of the squads, and particular attention is paid to the fire-fighting organization, the police service, the air-raid wardens, and the plant medical unit. Procedures to be followed during and after an air raid are outlined. *American Machinist*, May 14, 1942, pages 429, 430, 1 illus.

**New Overhead Conveyor System in Martin Bomber Plant.** Solutions of new and difficult problems in the handling of materials are presented in the form of a study of the overhead conveyor system installed in the bomber plants of The Glenn L. Martin Company. Among the benefits expected are a reduction of 30 per cent in the volume of traffic through the aisles and in the demands on the plant trucking facilities which are now overtaxed. It is also expected that the system will effect savings equal to the cost of installation within a period of 18 months. The conveyor

*Official photograph U.S. Army Air Corps.*
Heinkel He 11K-MkVa.

system is described, including details and dimensions of the parts and the construction methods employed. *Automotive and Aviation Industries*, May 15, 1942, pages 26, 27, 78, 4 illus.

## Plastics

**Working Transparent Plastics.** John Sasso. The second and concluding part of an article on the working qualities of acrylic sheets in which machining, finishing and repairing of cast sheets are discussed. *Aviation*, June, 1942, pages 105–109, 255, 6 illus.

**Plywood and Plastics . . . A Texas "Natural."** Victor H. Schoffelmayer. A descriptive summary of the natural resources of the southern states which can provide plastic materials for airplanes to replace metals. Possessing large timber reserves to supply cellulose and lignin, a vast concentration of sulphur, petroleum and natural gas, great deposits of salt and limestone, Texas and the states surrounding it are shown to have the raw materials for plywood and plastics. *Southern Flight*, May, 1942, pages 42, 44, 4 illus.

**Machining Laminated Plastics.** Herbert Chase. Procedures to be followed in the manufacture of laminated plastics for aircraft parts and for other applications are treated in considerable detail. The material is suitable for such operations as machining, punching or blanking. With standard tools and high speeds, light cuts are recommended in working this material. Information is given on the various methods of milling and punching. It has been found that laminated plastics are suitable for numerous kinds of aircraft parts. *American Machinist*, May 14, 1942, pages 434–437, 8 illus.

**Zinc Alloys for Molds.** J. Delmonte. Zinc alloy molds have been particularly valuable to the aircraft industry in the construction of dies for forming metal parts. The process is briefly described and some examples of work done with zinc alloy molds are discussed. Among the advantages claimed for this material are the low cost of molds for limited production and the ease with which it may be worked. *Modern Plastics*, May, 1942, pages 70, 108, 6 illus.

**High Density Plywood.** Thomas D. Perry. Methods of compressing plywood and bonding it with resin films are discussed and the products are compared with other methods. The effects of moisture are considered and industrial applications are suggested. It is concluded that there are many promising possibilities in these products, although the economic status and most logical uses of high-density plywood cannot be fully determined until production facilities are more adequate and more experience has been had with it. *Modern Plastics*, May, 1942, pages 61–63, 110, 112, 114, 3 illus.

**Progress in Methods of Edge-Gluing Lumber and Veneers.** H. K. Von Maltitz and O. Bolling. This paper describes methods and machines which have been developed recently for edge-gluing lumber and veneer with heat-setting adhesives that are waterproof and water-resistant. It refers particularly to urea-formalde-

hyde resin, comparing it with older adhesives and conventional methods of gluing. Advantages gained through the adoption of these new methods and materials are indicated. The machines and some of the processes are illustrated. *Transactions of the A.S.M.E.*, May, 1942, pages 387–392, 7 illus.

### Private Flying

**Cross Country Flying.** A. B. C. An exposition of the standard British procedure for nonscheduled cross-country flight, examining the available maps and weather forecasting system, the general altitudes for safe operation over various parts of Europe, landing and ground procedure, accepted departure preparations, routine structural inspection during a tour and a special examination of cloud formations and their significance. Particular attention is given to the air-speed indicator, and special conditions under which it cannot be relied upon, and also to mixture control and its effect on fuel economy. *Aeronautics*, May, 1942, pages 20–24.

**The Sky's the Limit.** Bill Green. The first of three parts of this article deals with the restrictions on private flying imposed by military regulations as experienced by the writer on a recent trip to Texas. It leads to his contentions that it would be more advantageous for the Army to construct new airports for their own use rather than take over existing civilian ones and that it would be in the interests of the war effort to provide qualified private flyers with the simplest possible method of obtaining weather information, clearances, and other data.

Arguing against the suppression of private flying, the second part of the article lists the contributions it has made to military aviation . . . . as a fountainhead of flying personnel, for the training expense it has saved the Army and Navy, as a potentially vital factor of defense, and as a means of releasing military aviators for combat duties. The third part of the article dwells on the suggestion that the Civil Air Patrol should come under the jurisdiction of the Army and Navy, rather than the Office of Civilian Defense and that in the face of all the work to be done this source of manpower, equipment and facilities should not be overlooked. *Southern Flight*, May, 1942, pages 18–20, 3 illus.

## Production

**Northrop Works Processes.** A survey of some of the production methods employed by Northrop Aviation. One part deals with its system of lofting with metal sheets; another with its aluminum alloy heat-treatment furnace for reduction of the time interval between heating and water quenching of materials. *Aircraft Production*, May, 1942, pages 373, 374, 4 illus.

**Precision Pipe Bending.** Economy of production time, together with a greater degree of precision and interchangeability in the finished parts, is stated to be the advantage of a new technique in pipe-bending methods developed by Blackburn Aircraft Ltd. Pipes are bent entirely by machine without needing skilled operators. How this is done is described at length and illustrated by various photographs and diagrams. The effect of bending on wall thicknesses and typical examples of production times are given in tabular form. *Aircraft Production*, May, 1942, pages 363–366, 11 illus.

**Building the Allison Engine.** Information on the production and assembly methods employed in the manufacture of the twelve-cylinder, 60-degree, V-type, ethylene-glycol-cooled Allison engine. Also detailed is information on the layout of this General Motors Division's plant at Indianapolis, the origin of the company, the construction of the engine and its development. In discussing the production processes attention is directed to the cylinder heads, cylinder block assembly, the crankcase upper half, the outer airscrew shaft, accessory drive housing, and hand operations. *Aircraft Production*, May, 1942, pages 348–354, 13 illus.

**Surface Finish.** A report on the research conducted by the Institution of Production Engineers with regard to surface finish for both moving and static parts. In a book by Dr. G. Schlesinger the results of the experiments have been collected and arranged as practical measuring units in a table giving data that describe approximately 500 surfaces of all types. This article is a review of the book. Among the points it covers is a brief explanation of the microinch, a unit of definite measurement for surface roughness, and the proposed British standards for roughness. *Aircraft Production*, May, 1942, page 343.

**Efficient Sub-Contracting.** F. C. Sheffield. In addition to details about the manufacture and assembly of lower defense mountings for bombers, plant layout and operational sequence are discussed in this article. The general design of the mountings, gun elevation and gun enclosure are surveyed. Planned production is discussed, with note made of the fact that no special tools are required, as well as the methods of machining cradles, tube manipulation and the welding shop. *Aircraft Production*, May, 1942, pages 327–331, 13 illus.

**Forming-By-Drawing.** Frohman Anderson. A new process in metal-forming known as "Forming-By-Drawing" is distinguished from rolling, stamping or stretching methods in that the metal is formed by controlled drawing actions applied to a moving sheet as it travels at selected speeds. A machine developed for this process consists of two principal units. The first is the "Forming-by-Drawing" machine through which flat sheets pass and emerge in curved form. The second machine serves to pull the sheet through the working units of the first machine. The machines are described and some of the processes are illustrated. *Aviation*, June, 1942, pages 82–85, 10 illus.

**Mass Producing the A-20 Bombers.** John D. Weaver. Description of the new mechanized assembly line used for the production of Douglas A-20 attack bombers, which are known in Great Britain as Bostons and Havocs. With increased production it became necessary to replace the "conventional" jig-to-jig system of production by the new "vertical" assembly line. *Aviation*, June, 1942, pages 86–91, 16 illus.

**Production Boosters at Fleetwings.** Perry Anderson. Two new devices to speed the production of aircraft parts have been developed by Fleetwing's specialists: one is a new machine for repacking bearings in control systems; the other, a machine adapted from a pneumatic compression riveter that punches holes in nose boxes for aluminum alloy control surfaces. Details are given on these two devices and their uses. *Aviation*, June, 1942, pages 111, 112, 5 illus.

**Engineering Liaison and Production Control.** Donald U. Kudlich. The Wright Aeronautical Corporation has organized an engineering liaison, responsible to the chief engineer, to investigate and coordinate change requests and production difficulties with the project engineers, the numerous research branches of the engineering department and the manufacturing department. This article gives an account of the manner in which the liaison group deals with many of the difficulties that arise between engineering and production departments and creates a better understanding between them. Examples of typical difficulties and methods of correction

are described. *S.A.E. Journal*, May, 1942, pages 169–176, 12 illus.

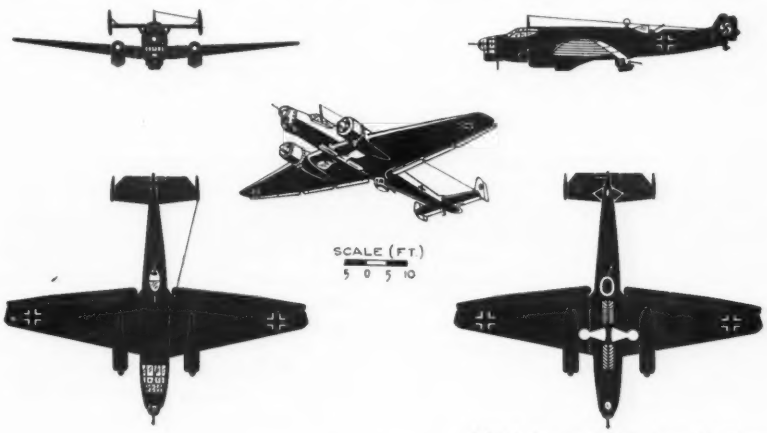
**Henry Ford—Plane Builder.** Douglas J. Ingells. The history of the production of aircraft and aircraft engines by organizations headed by Henry Ford is traced from the first experiences of his company in building Liberty engines in 1917. Mention is made of the manufacture of complete all-metal airplanes and of the operation of those machines in this country and abroad. It is recalled that the Ford interests operated an early aerial freight line, carrying automobile parts to factory branches in various cities, and that Ford dealers along the route made daily reports of weather conditions, constituting one of the first weather-reporting services for pilots.

Preparations for, and the actual production of, aircraft engines of Pratt & Whitney design are recounted, after which it is told how the Ford company undertook the construction of the Willow Run bomber plant and the manufacture of complete bombing aircraft. A brief description of the plant is given, together with some of the equipment and the time savings being accomplished. *Air Trails*, July, 1942, pages 12, 44, 46, 48, 3 illus.

**Welded Tube Production.** James E. Thompson. A diagrammatically illustrated explanation of the manufacturing processes involved in the mass production of aircraft welded tube structures. Welding methods, material preparation, assembly methods, and tooling are indicated as the basic factors influencing cost and production of these structures. Consideration is given to electric arc welding, profiling tube ends, slotting tube ends, jig clamps, tubing center locators, and pneumatic jigs for small welded parts. *Western Flying*, May, 1942, pages 46, 48, 50, 52, 7 illus.

**Three-Dimensional Views Boost Plane Production.** As an aid in speeding up production and to simplify the work for mechanics of limited skill, a method has been devised which is said to be an improvement over the use of complicated blueprints for assembly-line operations. Instead of conventional drawings requiring special training for their interpretation, sets of isometric or perspective drawings are prepared by engineers which present a more easily visualized picture of the parts to be assembled. The plan has been used successfully at the Douglas plants, is being adopted by other aircraft plants, and can be employed in any industry that uses an assembly-line system.

The "Production Illustration" type of drawing serves as a guide for the workers and is said to facilitate the work because it is easy to handle, omits all unnecessary detail and includes a handy list of the parts and tools required. The work is pictured step by step, showing exactly what is to be done by each group of men and at each stage in the production line. It is reported that in a test a crew working with production illustrations finished a job in less than two hours as compared with more than five hours required to do the same work by the use of ordinary blueprints. One of the difficulties has been in finding men capable of making these drawings, but the Art Center School at Los Angeles is giving a training course from which capable engineer-artists are going into the war industries, and a similar course was recently started at the University of Southern California. *American Machinist*, May 28, 1942, pages 505–509, 7 illus.; *Fortune*, June, 1942, pages 20, 22, 1 illus.; *Aviation*, June, 1942, pages 118–120, 6 illus.




*Official photograph U.S. Army Air Corps.*

Junkers Ju 86K.

**Bombers Get the Green Light.** R. A. Steinbauer. Precision methods of operation at a new, artificially lighted and air-conditioned bomber plant are portrayed in considerable detail. The layout of the new $10,000,000 plant is surveyed and the one-way flow of material is traced from the time it enters the receiving building. The type and arrangement of machines and the production methods followed are described and illustrated. *American Machinist*, May 28, 1942, pages 514–520, 11 illus.

**Adapting Facilities to Produce Bomb Fuzes.** One of a series of case histories gives the details of the conversion of industrial plants and their equipment for the production of bomb nose fuses. Information is given on the high-precision work required, including a list of the machinery available. One of the plants had formerly been manufacturing zipper fasteners and another had manufactured a variety of products including vacuum cleaners, electric blowers, exhaust units, electric floor polishers and can openers. *Metals and Alloys*, May, 1942, pages 770–772, 1 illus.

**Canadian Anson.** An examination of the changes in the structure of Federal Aircraft, Limited, of Canada, a government-controlled plant now building Avro Anson twin-engined operational trainers for the Empire Training Program. The article indicates the changes in design which were necessary for proper Canadian production, such as United States-built engines, hydraulic motivating equipment and Canadian accessories, and surveys the system of subcontracting now aiding the mass production of the Anson type. *Aeronautics*, May, 1942, page 37.

**Assembly in 5 Hours.** A camera study of the assembly of a Dornier Do 215 twin-engined light bomber, a process estimated by British experts to take about five hours. The photographs are reproduced from the official Luftwaffe periodical *Der Adler*. *Aeronautics*, May, 1942, pages 44, 45, 13 illus.

**U.S.A.: Production Rates.** Production figures on civil aircraft are given in detail for the first six months of 1941. Estimates of military production, and the value of production sent to Britain in the six months after passage of the Lend-Lease Act are included. *Interavia*, December 13, 1941, pages 16, 17.

**Canada: The Aircraft Industry.** A description of the development and expansion of the aircraft industry in Canada. *Interavia*, December 20, 1941, pages 16–19.

**U.S.A.: The Bomber Programme.** Expansion of new and already established plants and expenditures in-

volved in the American program are described. A summary of the contracts and production possibilities of some of the leading aircraft, engine, and aircraft parts manufacturers is given. *Interavia*, December 20, 1942, pages 7–11.

**The American Aircraft Production—Figures and Estimates.** Underestimation of enemy strength has had a decided influence on several phases of World War II during two and one-half years. This series of errors could be completed by an underestimation of the industrial capacity of the United States. Figures on 1941 production are given and production for 1942–1943 is estimated. The goal set by the United States Government is considered as of great magnitude, but the strength of the automotive industry, now geared to the production of aircraft, will be a factor in its accomplishment. The article speculates on the ability of the industry to attain this goal. The industrial setup and its estimated potential production are described in some detail as is also one of the four plants financed and built by the Government. *Interavia*, March 28, 1942, pages 1–10, 2 illus.

**Practical Rivet Standardization.** L. J. Fila. The average airplane of today contains over 150,000 rivets in its structure. Until recently at Lockheed there were 3,456 stock bins for different combinations of styles, alloys, diameters and length. The methods used by Lockheed in reducing the total number of combinations to 657 are described in detail. *Aero Digest*, June, 1942, pages 131, 132, 134, 136, 187, 2 illus.

**Drop-Hammer Methods in Aircraft Production—Part 2.** Chris J. Frey and Stanley S. Kogut. The second part of an article describing methods in drop-hammer die-making practice. Patterns, sand molds and die casting are discussed in detail. *Aero Digest*, June, 1940, pages 147, 149, 150, 152, 19 illus.

**Armstrong Converts Plants to Aircraft Parts Construction.** Before the end of 1942 the various factories of the Armstrong Cork Company of Lancaster, Pa., will be converted to aircraft subcontracting and the production of other war materials. A description of the change-over from the peacetime production of linoleum and cork products to the manufacture of aluminum wing tips and spars is contained in this short article. *Aero Digest*, June, 1942, pages 170, 310, 3 illus.

**Auto Plants Sprout Wings.** A brief summary of the war production of the automotive industry. In 1941 the industry produced approximately five billion dollars worth of automobiles, trucks and parts, and one billion dollars worth of war machines. Now, the 180 companies, including automobile, truck and parts manufacturers, are expected to turn out 14 billion dollars worth of war materials annually. Their principal products will consist of aircraft, parts and engines. *National Aeronautics*, June, 1942, page 18, 3 illus.

**Subcontractor Cites His Experience in War Orders.** W. G. Green. Stating that the experience will help the manufacturer as well as his country, this is a recommendation for manufacturers to get their plants into war work and some advice to guide them in doing so. Suggestions offered are: efficiency and close inspection of parts produced for the Army will be necessary; in subletting work, careful supervision must be maintained over the subcontractor; adequate financing must be provided for; priorities need not be feared; and extra costs in Government work must be taken into consideration. However, it is claimed, the manufacturer will benefit by the greater accuracy and speed imposed by the rigid military specifications and by an enlargement of his sphere of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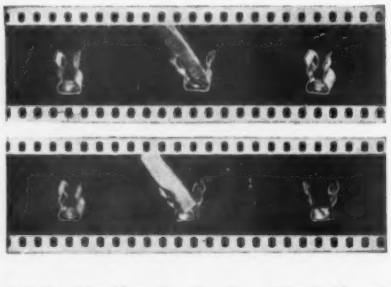

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activity. *Southern Flight*, May, 1942, pages 60, 61, 70.

**Buick's Warplane Engine Plant.** Joseph Geschelin. A description is given in considerable detail of the Buick plant for the production of aircraft engines. The construction of the buildings is detailed, along with the production equipment and the machinery employed for the transportation of materials within the plant. Gear, metallurgic and tool practice and other special processes are outlined, and the testing facilities are discussed at length. Illustrations show many of the machines and methods used. *Automotive and Aviation Industries*, June 1, 1942, pages 20–27, 82, 22 illus.

## Propellers

**Airscrews For High-Speed Aircraft.** F. Weinig. A translation from *Luftfahrtforschung*, Vol. 14, No. 4–5, April 20, 1937, pages 168–172, published by permission of the Ministry of Aircraft Production. This article states that propeller performance may be increased by three means: (1) increase of the diameter; (2) increase of the number and width of the blades; (3) increase of the peripheral speed. The propeller diameter and the number and width of the blades are limited, but these limits have not yet been reached in practice. The speed of sound, however, does set a definite limit on the peripheral or tip speed. Before this speed is attained, a marked decrease in propeller efficiency may be noted. There is, therefore, need for reducing peripheral speed with the increase of flight speed. With peripheral speed reduced and simultaneous increase of the diameter, the r.p.m. value decreases and with simultaneous increase of power the free torques become great. For twin-engined aircraft, propellers in opposed rotation are recommended. *The Journal of the Royal Aeronautical Society*, May, 1942, pages 115–124, 12 illus.

**Paddle-Blade Propeller.** Spencer Gregg. The paddle-blade propeller has been designed and developed by Hamilton Standard at the request of an important constructor of military aircraft. The propeller is designed to absorb the power output without increasing the diameter. For this purpose, instead of tapering the blades it was decided to widen them with a minimum of added weight. It is expected that the paddle blades will reduce power losses at high altitudes and that they will produce higher speeds, greater climb and ceilings. *Flying and Popular Aviation*, July, 1942, pages 45, 46, 102, 103, 2 illus.

**Great Britain: Rotol Contra-Rotating Airscrew.** Three-blade counter-rotating Rotol propellers are described in some detail. The blades of both propellers are rotated around their longitudinal axes by means of a common pitch-changing mechanism controlled by a governor. As with the single Rotol propeller, the pitch-changing mechanism incorporates a fixed piston and an axially moving cylinder. The weight of the Rotol counterrotating propeller exceeds by 10 to 20 per cent that of the single three-blade propeller designed to absorb the same power. *Interavia*, March 16, 1942, pages 7, 8, 1 illus.

**Manufacturing Propeller Hubs.** R. Eric Crawford. Following two previously published articles on the production of the blades and operation of the propeller, this is a description of the manufacture of the hub for the Hoover propeller. Giving the mechanics of construction and procedure and the materials used, it relates how each process contributes in natural sequence to the ultimate product. *Canadian Aviation*, May, 1942, pages 51, 52, 54, 56, 58, 13 illus.

## Radio

**Flying, as It Was.** E. B. Berlinrut. An account of the aircraft radio development work carried out by the Bell Telephone Laboratories under the direction of A. R. Brooks. Attention is particularly focused on research in air passenger phone facilities. *The Sportsman Pilot*, May 15, 1942, pages 14, 15, 34, 4 illus.

**Emergency Radio.** Quoted from reports made by the British Ministry of Aircraft Production, data are given on two types of emergency radio transmitters carried in German aircraft. Designed for use from land, the N.S.1 "notsender" is a self-contained portable transmitter that can be utilized for hand-keyed or automatic continuous-wave transmission. On automatic sending it transmits S.O.S. three times, then a long dash, then repeats. With a frequency coverage of 320 to 532 kc., it is tuned for spot frequency at 500 kc. The N.S.2 "notsender," for dinghy transmission, is carried loose in the aircraft and consists of two parts, the transmitter and the accessory container, both of which are watertight and buoyant. *Flight*, May 7, 1942, pages 456, 457, 4 illus.

**Finessing the Radio Range.** J. A. Gianelli. Meant for readers who are preparing for an instrument rating, this article serves as a memory refresher. The True Fadeout and Universal Methods of orientation are described, as well as the 90-deg. turn, the fade-out parallel and the fade-out perpendicular. Advice is given on how to identify a quadrant, how to check position and how to avoid turning in circles in order to remain on the beam. *Aero Digest*, June, 1942, pages 91, 92, 3 illus.

## Research

**Germany: Heidelberg Aeronautical Institute.** It is reported that the Luftwaffe intends to establish an aeronautical research institute at Heidelberg University. Activities of the institute will cover the auxiliary fields of the aeronautical sciences, including those based on the natural sciences, such as mathematics, chemistry, physiology and geology, as well as aeronautical operations, air law and aeronautical medicine. *Interavia*, March 28, 1942, page 15.

**World's Biggest Aircraft Engine Laboratory Begins Activities.** In an account of the ceremonies connected with the dedication of the new aircraft-engine research laboratory of the National Advisory Committee for Aeronautics, at Cleveland, a brief description is given of the new facilities.

The laboratory, which will cost over $18,000,000 when completed, occupies a site of 200 acres and will have 16 units. It has two torque stands that are able to test engines up to 4,000 hp. Five other units under construction will include what is said to be the only engine research wind tunnel of its type in the world, in addition to a fuel and lubricant building, a flight research hangar and an ice tunnel. Examples of the work that can be done in the research building are the study of multicylinder power plants in units of a single cylinder or in their entirety, engine accessories, stresses of engine parts and the recovery of heat losses. Attempts to increase power by greater utilization of waste heat will be among the projects attempted. The N.A.C.A. is reported to regard as one of its most important problems the increase of power without materially raising the size or weight of the engine. *U.S. Air Services*, June, 1942, pages 13–15, 2 illus.

## Rotating Wing Aircraft

**Technical Development of the VS-300 Helicopter During 1941.** I. I. Sikorsky. The VS-300 is technically described. Maneuverability on land and water is noted. Comments are made on three important recorded flights that were achieved during 1941 with the VS-300 helicopter. On April 15 a national endurance record of 1 hour, 5 min., 14.5 sec. was established; on April 17 the amphibian characteristics of the helicopter were successfully demonstrated for the first time; and on May 6 a new international endurance record of 1 hour, 32 min.,

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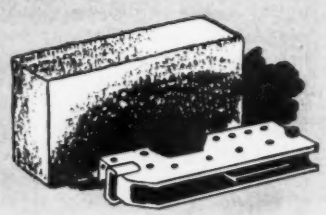

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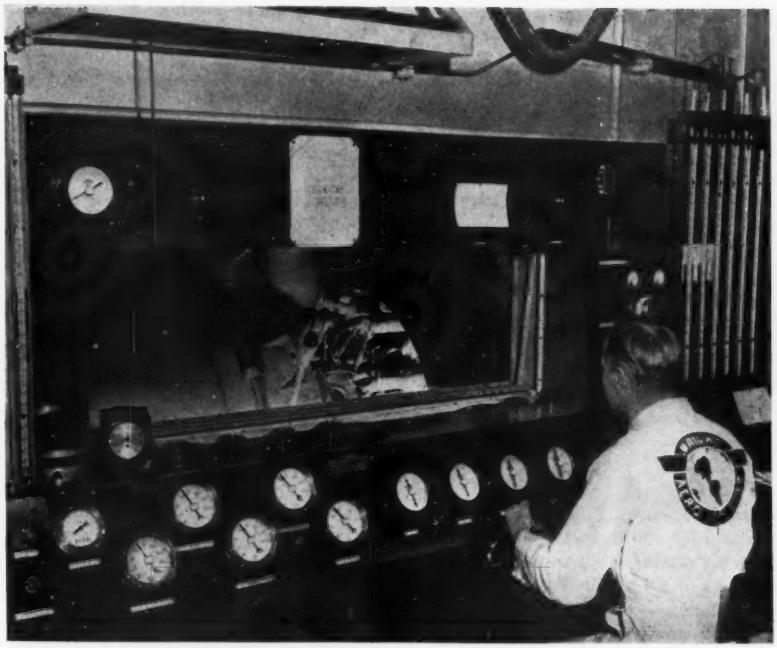
26.1 sec. was made. Modifications envisaged for the future include refinement of controls to improve stability. *Journal of the Aeronautical Sciences*, June, 1942, pages 309–311, 4 illus.

## Stress Analysis

**The Strain Gauge as an Aid in Aircraft Structural Design.** Application of the strain gauge as a useful instrument to measure small deformations due to loading of mechanical members is described. The article deals with the electric strain gauge as used in the design of aircraft structures. The instrument comprises resistance units that are cemented to the strained part, together with amplifying and recording apparatus. The equipment, as well as the methods followed in using it, is described in detail. Various examples are given of the uses of the instrument in determining load stresses, bending stresses and shear stresses. Other uses are also pointed out. *Automotive and Aviation Industries*, June 1, 1942, pages 40–43, 7 illus.



The control panel of an aircraft engine test stand at Wright Aeronautical Corporation. A Wright Cyclone engine is shown under test in this view.

## Testing

**X-Ray of Aircraft Castings—Its Control and Value.** B. C. Boulton. X-ray inspection is a valuable tool for certain important classes of material. Its principal function is to assist in the initial development of correct design, dies or patterns, and foundry technique. Its second basic function is the maintenance of a continuing control over foundry practice to insure maintenance of quality.

Only by the establishment of comprehensive and carefully maintained routine controls can x-ray inspection be effective or economical. To secure proper value from x-ray inspection in maintaining quality standards there must be a proper follow-up on the information given by the control data. Once properly established, the cost of maintaining suitable controls is relatively small even with large production.

X-ray inspection alone has only qualitative and comparative value in determining the structural airworthiness of parts with defects. Defects that can be revealed by x-ray have a marked detrimental effect on the impact and fatigue properties of castings, much greater than the effect on static strength.

The standards for rejection by x-ray inspection should not be based on the absolute value of the casting quality but on airworthiness considerations and should take cognizance of the ratio between the actual strength of a sound casting and its design load and also whether the part is subject to unusual conditions of impact or fatigue. Tables set forth summaries of rejection experiences and results of tests for fatigue and impact tension. *Journal of the Aeronautical Sciences*, June, 1942, pages 271–283, 10 illus.

**Preliminary Static Test of a Magnesium Alloy Wing.** Emerson W. Conlon and John C. Mathes. Generally speaking, magnesium alloy is passing through the same development cycle as aluminum alloys, with similar difficulties in forming, surface protection and other factors. Comparisons are made between magnesium alloys and aluminum alloys as were experienced in the early days of aluminum airplane development. On an experimental outer wing panel designed for a North American trainer, the completed panel weighed 18.7 per cent less than the aluminum counterpart. The weight saving due to substitution of magnesium for aluminum resulted in an increase of bending deflection of the same relative magnitude. As anticipated, the lighter experimental wing had less torsional rigidity and more torsional deflection. The critical flutter speed was calculated theoretically and it was determined that since both bending and torsional rigidity decreased there was little change in critical flutter speed.

Of equal interest with the weight-saving possibilities are the utilization of magnesium and its low specific gravity in the design and construction of more nearly pure monocoque assemblies. The saving in cost, the added space made available in the structure for armament, equipment or tanks and the smooth surface obtained are all pertinent considerations that indicate the desirability of this development. *Journal of the Aeronautical Sciences*, June, 1942, pages 284–289, 17 illus.

## Testing Equipment

**Ground Versus Flight Tests of Aeroplane Engine Installations.** James B. Kendrick. The writer asserts that development and service tests may be accomplished in the wind tunnel in a shorter elapsed time and at a fraction of the total cost of such tests conducted on the airplane in flight. A comparison of the results of ground tests on the Vega Ventura engine installation with flight-test results indicates some factors in ground-test technique which should be satisfied in order to obtain reliable results. Various types of testing equipment are described, such as a new compact arrangement of the closed-return wind tunnel, which appears to offer the greatest advantages for general testing. Comparison serves to strengthen the writer's conviction that preflight proving of engine installations can be accomplished effectively if proper care is taken to simulate flight conditions. *S.A.E. Journal*, June, 1942, pages 241–251, 13 illus.

## Tools and Equipment

**An Expanding Industry.** An account of the processes to which diamonds are subjected in preparing them for industrial purposes. This is based on the methods used in a particular factory in England established by refugees from the Low Countries after their invasion by Germany. *Aircraft Production*, May, 1942, page 362, 1 illus.

**Duplicating Templates by the X-Ray Process.** Application of the phototemplate method at the North American Aviation home plant is described and illustrated. The process and the apparatus used are covered and some of the benefits derived are outlined. The operating expenses for this system are low and the initial cost is moderate—North American equipped its laboratory at a cost of about $6,000, indicating that it is possible for a small manufacturer to take advantage of this method. *Automotive and Aviation Industries*, May 15, 1942, pages 44, 45, 70, 3 illus.

# Training

**CAA to Train Traffic Control Personnel.** Leonard Eiserer. Plans are outlined for a nationwide training program for airtraffic personnel under the auspices of the Civil Aeronautics Administration. This program is being established to provide replacements for personnel called into the active service. Some figures are given on the increase in air traffic in recent months. *American Aviation*, May 15, 1942, page 30, 1 illus.

**Training Paratroops.** S. R. Winters. The training of American paratroops and the technique of jumping are described. It is indicated that, contrary to general belief, the number of injuries suffered by the men of the parachute battalions is small. During a period of 18 months in which about 21,000 jumps were made, there was a total of but 1.04 per cent injuries. *Aero Digest*, June, 1942, pages 95, 96, 99, 102, 7 illus.

**In Formation, Please.** K. L. Lester. An aviation cadet relates his first experiences in formation flying. Observations are given on various kinds of formation units and their purposes. *Air Facts*, June, 1942, pages 16–21.

**Texas Colleges Busy With Aeronautics.** Byron Winstead and M. J. Thompson. Two separate accounts of the aeronautical engineering courses for undergraduates and graduates now being given at Texas A. & M. College and the University of Texas. Commendation is also given to the coordination of this educational program with military and industrial application. *Southern Flight*, May, 1942, pages 46–48, 3 illus.

**U.S. Agencies Train Texans for Aircraft Industry.** Al Harting and Dorothy Baldridge. Estimating that thousands of Texas war workers are being recruited from the W.P.A. and the N.Y.A., this report tells of the preliminary training they receive and the efficiency with which they are performing their new jobs. The two agencies are not only training workers for war industry jobs but, with the assistance of the United States Employment Services, are helping to find these jobs for them. Attention is directed, too, to the other side of the problem . . . . that of giving instruction and work experience to thousands of people. It is said that the W.P.A. and the N.Y.A. are expediting production by supplying the aircraft and allied industries with a constantly flowing new supply of trained labor. *Southern Flight*, May, 1942, pages 50, 52, 1 illus.

**Making America's Sky Warriors.** Maj. Gen. Barton K. Yount. The Commanding General of the Flying Training Command states its purposes and the means by which it expects to carry out its program. Created by the Army Air Forces to consolidate all of the training centers under one unified control, the Command's function is to furnish the combat forces with an ever-increasing supply of competent personnel. It is their intention to coordinate the training and aircraft procurement schedules so that the proportion of pilots for fighter airplanes, two-engined and four-engined bombers, bombardiers, navigators and gunners will conform with the delivery of airplanes. The writer also touches upon the contributions that are expected of the C.P.T. units. *Southern Flight*, May, 1942, pages 64, 65, 1 illus.

**We Win Our Wings.** Devon Francis. The writer presents a human-interest description of the life of the cadet from his entry into an Air Corps training center until he emerges as a fighting cadet. How the pick of American youth earns his wings, and what makes a good pilot are discussed. *Collier's*, June 13, 1942, pages 20, 21, 58–60, 5 illus.

**Are We Forgetting Youth?** Dr. Alexander Klemin. The writer refutes the arguments of people who are doubtful of the value of air youth activities and describes briefly the benefits that youth can derive from this training. The flying of models by youths, it is stated, creates an interest in aerodynamics and leads to a further study of the principles of mechanics and physics. *National Aeronautics*, June, 1942, pages 19, 37, 1 illus.

**The Story of Brooks Field.** This article tells of the type of training the students undergo at the Advanced Observation Flying School at Brooks Field in Texas. Special professional qualifications necessary to the good observer include a basic military education, proficiency in all means of communications, a knowledge of photography, sketching, map reading, navigation, gunnery, pilotage and preparation of pilot-observer reports. *Dixie Air News*, May, 1942, pages 3–5, 21, 12 illus.

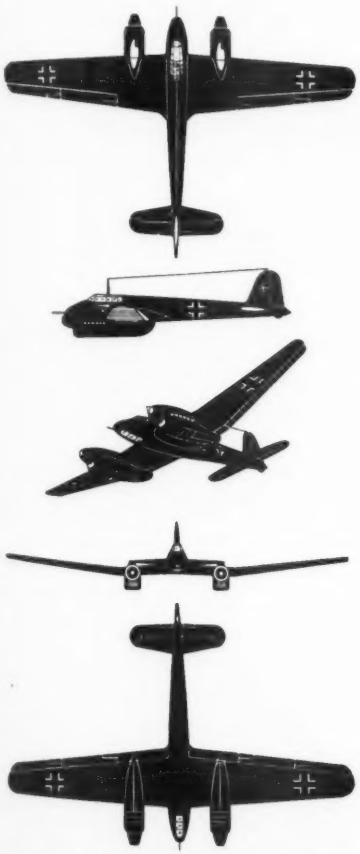
**Airmen by the Thousands.** Maj. Gen. Barton K. Yount. The attainment of the Army Air Forces' goal of 1,000,000 trained men and officers by the end of 1942 is dependent upon two training commands: the Air Forces Flying Training Command, in charge of pilot, bombardier, navigator, gunner, and glider training; and the Air Forces Technical Training Command, charged with the instruction of the maintenance and service crews. This article also gives details on the elementary and advanced training courses for pilots, bombardiers and navigators. *Flying and Popular Aviation*, July, 1942, pages 22, 23, 81, 82, 4 illus.

**Conversion School.** James Montagnes. Data on the conversion training course at Rockcliffe where Royal Canadian Air Force staff pilots learn to fly every type of aircraft used by the R.C.A.F. These staff pilots are needed at air training schools and regional headquarters to fly target airplanes at gunnery schools, to ferry airplanes from factories to air bases and training fields, and for various other jobs. The four basic-type airplanes used for the instruction of staff pilots are: the single-engined Fairey Battle two-place fighter; the single-engined two-seater North American Harvard, for advanced training instruction; the twin-engined Airspeed Oxford, a three-place bomber with revolving rear turret; and the four-place twin-engined Bristol Bolingbroke bomber with revolving rear turret. *Flying and Popular Aviation*, July, 1942, pages 43, 44, 1 illus.

**"Air Conditioning" the U.S.** An outline of the proposed plans sponsored by the United States Office of Education and the Civil Aeronautics Administration for stimulating aviation education in elementary schools and high schools. By turning over to the secondary schools responsibility

for teaching aeronautical fundamentals, the program is intended to create in youngsters a thorough knowledge basic to pilot candidacy and to increase public interest in aviation by making people "grow up" with aviation. The article also contains an account of the training course being given to three classes of pilots for the Army Ferrying Command at the C.A.A. Standardization Center in Houston, Tex. *Yankee Pilot*, May, 1942, pages 18, 19.

**Hangar Flying.** An evaluation of preliminary light airplane training for students who expect to fly more com-



*Official photograph U.S. Army Air Corps.*
Focke-Wulf FW 187.

plex and heavier airplanes. The potential usefulness of the light airplane is demonstrated, while any reason for its failure in this respect is blamed chiefly on vague and inefficient methods of instruction. Instruction, it is stated, must tend toward the development of habits, attitudes, and methods that may be unnecessary for light airplane flying but which are necessary for more difficult flying jobs.

Concentration on four factors is recommended for light airplane instructors who would adequately prepare their students for more advanced training. These points are: (1) purposeful and accurate maneuvering at all times—turns to be of some definite degree, climbs at a definite angle, and glides at a definite speed and landings on a definite point; (2) all landing approaches to be of the standard key-position type, aiming for a particular landing spot and reaching it by a carefully planned pattern of maneuver, avoiding particularly the wide, long "swoop" of indefinite speed; (3) the development of a constant sense of responsibility for all other aircraft in the vicinity, involving frequent practice in the simultaneous landing of several airplanes; (4) constant emphasis upon the necessity for complete self-reliance and control of the airplane, avoiding the tendency to let the airplane take care of itself when in difficulty—an expedient that works in light airplanes but not so well in heavier ones. *The Sportsman Pilot*, May 15, 1942, pages 12, 13, 34, 35, 1 illus.

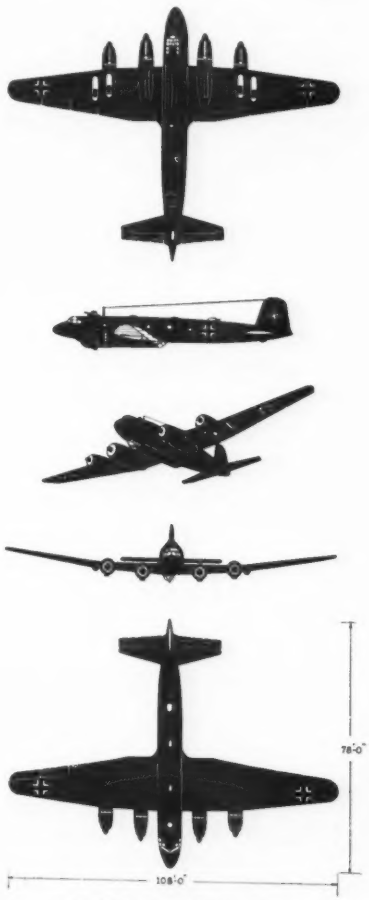
**In the Army and Navy Flying Schools.** The intensive course of instruction undergone by students at the training school for bombardiers at Albuquerque, N.M., is related in detail. Data are given on preliminary training, ground training and air training, mention is made of the men in charge of and responsible for the acceleration of the program, and emphasis is placed upon the importance of teamwork in bombardment. *The Sportsman Pilot*, May 15, 1942, pages 18, 19, 40, 42, 6 illus.

## Warfare

**With the R.A.F. Wing in Russia.** A group of pictures portray the living and working conditions of the R.A.F. Wing in Russia. Equipped with Hurricanes, the primary duty of the Wing was the instruction of Russian air units in the operation and maintenance of this airplane. However, this report relates how they did more than instruct . . . . they went into action with effective results that meant not only losses to the Germans but closer cooperation between the air forces of Britain and Russia. *Flight*, April 16, 1942, pages 370a, 370b, 20 illus.

**A Norwegian Fighter Squadron.** A brief account of the three operational squadrons of the Royal Norwegian Air Force, now in service with the Royal Air Force. One squadron in Iceland flies as a unit of Coastal Command and is equipped with Northrop N-3PB twin-float seaplanes. The other two, using Supermarine Spitfire Vbs, are fighter squadrons working the R.A.F. in the United Kingdom. Mention is made of the many ways by which the men escaped from Norway to join these squadrons and of the Norwegian Air Training Centre in Ontario, Canada. *The Aeroplane*, May 1, 1942, page 510, 2 illus.; *Flight*, April 30, 1942, pages 419–421.

**Hitler's Secret Threat?** Leonard Engel. Speculation is undertaken concerning the new weapon that may be produced by the Germans for the campaigns of 1942. Reviewing the action of torpedo bombers, the writer indicates that these may be the so-called new weapons. The construction of the aerial torpedo is described, as well as the methods of launching it, and some of the torpedo-carrying




*Official photograph U.S. Army Air Corps.*
Focke-Wulf FW 200K.

airplanes of the opposing forces are shown and discussed. Limitations on the use of aerial torpedoes are outlined. *Air News*, June, 1942, pages 6–9, 28, 17 illus.

**The Civilian Pilot Fights the Submarine.** Kurt Rand. This report on the antisubmarine and other operations of the Civil Air Patrol surveys the expansion of its functions as an aerial auxiliary. It outlines the organization, background, training and usefulness of the C.A.P. task force units and lists the qualifications for eligibility for the C.A.P. *Flying*

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*and Popular Aviation*, July, 1942, pages 18–20, 100, 101, 6 illus.

**The Royal Observer Corps.** Alfred Toombs. Methods employed in England of selecting airplane spotters, training them, and utilizing them are told. Members of the Royal Observer Corps receive training in recognition of different types of airplanes, in altitude finding, and in plotting the course of aircraft. Spotters are trained to recognize aircraft through the study of silhouettes, photographs and films of airplanes of all countries. *Flying and Popular Aviation*, July, 1942, pages 38–40, 84, 86, 3 illus.

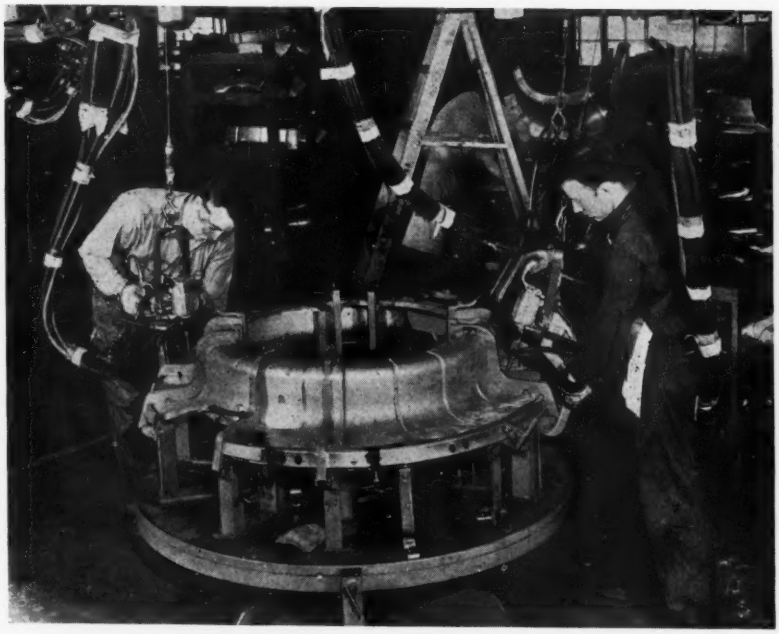
**A Civil Air Patrol Task Force on Active Duty.** Offered as a proof of the Civil Air Patrol's potentialities, this is a report of the activities of one of their task units assigned to coastal reconnaissance duty. Cooperating with the Army and Navy in the hunt for submarines and wreck survivors, civilian pilots flew a constant patrol over specified areas. Details of their flights, the men who comprised the Task Unit, and the conditions under which they worked are given.

The first flight described demonstrated several tactical facts; viz., that certain types of airplanes could not keep up with the rest, that the best altitude at which to fly was between 300 and 500 ft., and that formations of two or three airplanes were best. *The Sportsman Pilot*, May 15, 1942, pages 8, 9, 48, 1 illus.

**America vs. The Axis.** A brief illustrated description of trainers and first-line aircraft of the United States and Axis Nations. Mention is made of new American aircraft now in production. *National Aeronautics*, June, 1942, pages 22, 23, 35, 16 illus.

**Precision Bombing Takes Teamwork.** Hickman Powell. How the crew of the modern heavy bomber is assembled and taught to coordinate their duties like a smoothly functioning athletic team is told in this account. Each man a specialist in his particular work, the bomber crew is composed of pilot and copilot, navigator, bombardier, radioman and assistant, aerial engineer and assistant, and the rear gunner. The functions of each are explained and the high degree of teamwork is emphasized. It is noted that during the tense moments when the bombs are being aimed and dropped, the bombardier is actually in command of the aircraft. *Popular Science*, July, 1942, pages 102–107, 202, 11 illus.

**"To Tokyo, Dammit!"** John R. Morris. This is a roll call of the fighting men of the American Air Forces in India. It tells of the action from the Philippines to India—what they did over Bataan, Macassar, Malang, and Jokyakarta—and what they plan to do now that the tide is turning toward offensive action. Information is given on the organization, equipment, living and fighting conditions of the Army Air Forces in India. *Collier's*, June 6, 1942, pages 12, 13, 61, 3 illus.



Spot welding a Flying Fortress cowling in a Fisher Body plant.

## Welding

**Arc Welding of Sheet Metal.** J. V. Thomas. Part I of an article dealing with the advantages of the welded joint, jigs and fixtures, and the type of electrode. *Sheet Metal Industries*, May, 1942, pages 677, 678, 3 illus.

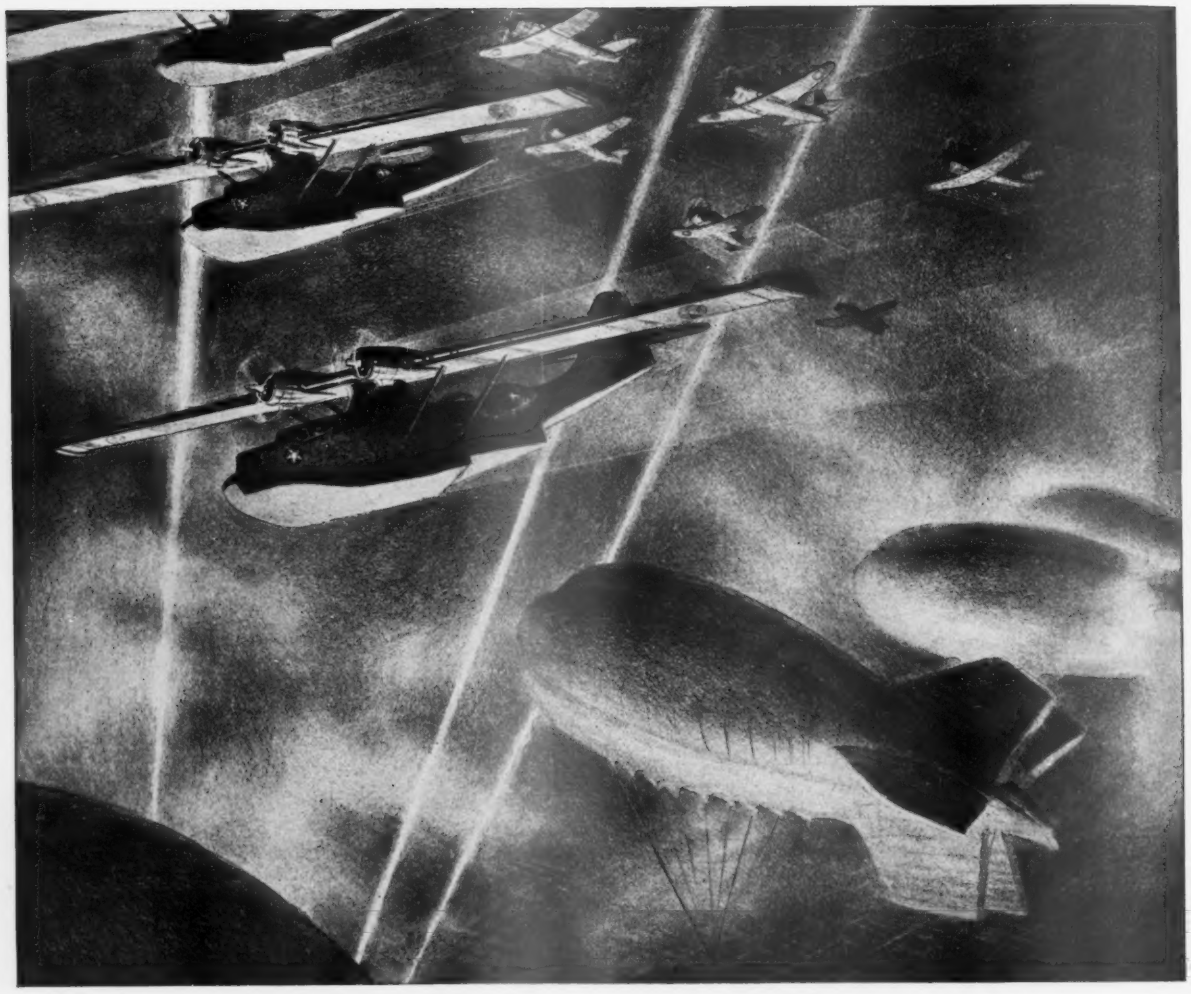
## Wind Tunnels

**A New Two-Parameter Model Suspension System for the Galcit 10-Ft. Wind Tunnel.** Arthur L. Klein, Peter V. H. Serrell, and Clark B. Millikan. This new system incorporates the truncated pyramid type of suspension with modifications introduced as a result of the particular requirements of the GALCIT laboratory. The model is mounted in the inverted position so that positive lift loads are downward. All six components are measured with respect to wind axes, and moments are measured about the point of intersection of the wing trunnion axis and yaw axis, this point remaining stationary with respect to the reference framework for any change of attitude of the model.

In this type of suspension system the friction at the trunnion bearings introduces no error in the moment readings and, as a result, the static moment compensating system can be added to the angle of attack linkage, and electric power, water and pressure tubes can be run into and out of the model through the tail strut, all without affecting the accuracy of the force or moment measurements. Feedback levers and totalizing beams have been provided so that each component of force and moment is read on a separate balance.

The most important features of this system are: (1) the possibility of using pitch and yaw as free parameters; (2) the separation of forces and moments into individually observed components; (3) the elimination of all gravity moments; (4) the elimination of friction about the pitch or yaw axis as a source of error; (5) the great flexibility in model support locations; (6) the possibility of measuring positive and negative lifts of approximately equal magnitude. *Journal of the Aeronautical Sciences*, June, 1942, pages 302–308, 11 illus.

**Wind Tunnel Tests.** L. Leavy. A layman's explanation of the manner in which information obtained from wind-tunnel tests is applied to the actual task of designing an airplane. Using as an example a typical twin-engined monoplane, the article outlines the method by which wind-tunnel results are used to determine what characteristics shall be incorporated into the future design to achieve the wanted performance and how wind-tunnel figures are calculated to justify the validity of the results. *Aeronautics*, May, 1942, pages 52–57, 7 illus.



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# Government Publications

## U.S. Army Air Forces

**Directory.** The Publications Section of the Public Relations Division of the Army Air Forces has issued a directory containing lists of the personnel of the various Government bureaus dealing with aeronautical and other matters, including the Army Air Forces, Army Ground Forces, Services of Supply and other Government and information agencies. It includes a list of civilian organizations representing the aeronautical sciences and industries, aircraft manufacturers, air lines, aviation publications and the Aviation Writers Association. Addresses and telephone numbers are given as of May 1, 1942. *A.A.F. Public Relations Directory.* Publications Section, Public Relations Division, Army Air Forces.

**Enemy Aircraft—Messerschmitt Me. 109.** An advance release from the *Army Air Forces Newsletter* of June 20 gives a complete description of the Messerschmitt Me 109, as published by the Royal Aircraft Establishment of Great Britain. The survey covers the handling characteristics of the aircraft, the cockpit control arrangements, the design for ease of production and maintenance provisions. Specific information is given under suitable headings to show the characteristics of construction and operation of all of the major parts of the aircraft and its controls. *Army Air Forces Newsletter*, June 20, 1942.

## Navy Department Bureau of Aeronautics

The Bureau of Aeronautics has issued *Technical Note No. 36-42* containing maintenance information on model ZA instrument landing equipment, based on the fact that certain aircraft glide path antenna installations have been found to lose sensitivity subsequent to installation. The following recommendations of Patwing SEVEN are briefed for the information of units using this equipment:

For squadrons using the subject equipment it is recommended that the antenna head be coated on the inside with a good sealing material such as Glyptol, to retard the corrosive action and that the antenna head be removed monthly for cleaning and inspection.

In the event of an actual failure it is recommended that the present transmission line from the antenna head to the glide path receiver be replaced with the type PT-5 (Navy type CASSF-50-1) radar coaxial transmission line. This will not only stop the present failures but will improve the performance of the glide path equipment. The type PT-5 has much better electrical characteristics, its losses being lower and the insulation being better than that available in the currently used transmission lines. The signal strength received using the type PT-5 line is approximately 3 to 1 with respect to the present line. The above information was obtained from tests made in Patrol Squadron Seventy-Four's Plane 74-P-5, using an actual installation.

Future procurement of ZA landing equipment will incorporate the changes outlined in the preceding paragraphs, but meanwhile the procedures given should be followed as indicated.

## National Advisory Committee for Aeronautics

**Pressure Distribution on Wings in Reversed Flow.** A. Naumann. Translation of an article entitled "Druckverteilung an Flugeln bei Anstromung von ruckwarts," from Jahrbuch 1938 der deutschen *Luftfahrtforschung*. The series of pressure distribution measurements at three test sections on N.A.C.A. airfoils 2212 and M6 within 170- to 210-deg. angles of attack in reversed flow proved to be largely independent of the profile form. In contradiction to the pressure distribution in normal flow, considerable negative pressure from the upper surface spills over onto the lower surface and vice versa, even in the zone of sound flow. The results are presented as chordwise pressure and load distribution. The spanwise lift distribution and the total lift coefficients of the wing obtained by integration manifest approximate agreement with the behavior of a diagonally disposed flat plate. By consideration of the ground effect, represented by a flat wall, the lower surface of the wing shows an increase in the low pressure. *N.A.C.A. T.M. No. 1011*, April, 1942.

**Recent Results in Rocket Flight Technique.** Eugen Sanger. Translation of an article from *Flug* entitled "Neuere Ergebnisse der Raketenflugtechnik." The concept of the effective ejection velocity of a rocket engine is explained, and the magnitude of the attainable ejection velocity is theoretically and experimentally investigated. Velocities above 3,000 m. per sec. (6,700 m.p.h.) are actually measured and the possibilities of further increases are shown. *N.A.C.A. T.M. No. 1012*, April, 1942, 47 pages, 24 illus.

**Statistical Analysis of Service Stresses in Aircraft Wings.** Hans W. Kaul. Translation of an article "Statistische Erhebungen über Betriebsbeanspruchungen von Flugzeugflugeln," from *Jahrbuch 1938 Der Deutschen Luftfahrtforschung Supplement.* It is apparent that studies of strength requirements under recurrent stresses are of major concern. This is particularly true with reference to the wing structures of modern high-speed aircraft under the comparatively high service stresses and the increasing number of hours of operation required during the life of the separate airplane parts. Exhaustive studies were made by the DVL for certain structural types of airplanes and some of the results are reported in this article.

Three major purposes are indicated for undertaking a statistical analysis of service stresses. The first is to establish the number of recurrences at which certain reference values of the stresses are reached over a sufficiently long period of time by a certain type or by a certain group of the same type. Such work is based on measurements made on an airplane designed for a specific purpose, such as commercial, touring, acrobatics or

some other purpose. The second problem involves a compilation of statistical data based on systematic measurements under certain conditions as may be applied to any other type of aircraft by means of aerochemical or other considerations, thus permitting the prediction of the service stresses to be expected on a new type whose purpose is known. The third problem involves the solution of definite aeromechanical research tasks. Statistical analysis can be useful in aeromechanical research problems involving confirmation of theory by flight tests under conditions where a single measurement cannot be repeated—for example, in the recording of stresses due to gusts.

Some of the results of these investigations are set forth in text and in charts. *N.A.C.A. T.M. No. 1015.*

**Recording Rapidly Changing Cylinder-Wall Temperatures.** Adolf Meier. Translation of an article "Messung schnellveranderlicher Zylinderwandtemperaturen," from *Forschung auf dem Gebiete des Ingenieurwesens*, January–February, 1939. This report deals with the design and testing of a measuring plug suggested by H. Pfriem for recording quasi-stationary cylinder-wall temperatures. The new device is a resistance thermometer; the temperature-susceptible part consists of a gold coating applied by evaporation under high vacuum and electrically strengthened. This resistance layer, being located on the surface of the wall, makes possible an immediate surface temperature reading not obtainable heretofore with the conventional thermocouples. Its inertia is negligible. The uncertain and tedious conversion of the test data to the surface is eliminated. A further advantage over the thermocouple lies in the much higher current fluctuations that permit the charting of the temperature curve without amplification. The new method combines substantially higher instrumental accuracy with a maximum of simplicity in operation. Eventual correction of test data is greatly simplified by the laminated structure of the measuring plug.

After overcoming initial difficulties, calibration of plugs up to and beyond 400°C. was possible. The measurements were made on high-speed internal combustion engines. The increasing effect of the carbon deposit at the wall surface with increasing operating period is indicated by means of charts. *N.A.C.A. T.M. No. 1013.*

**Investigation of Lubricants Under Boundary Friction.** E. Heidebroek and E. Pietsch. Translation of an article "Untersuchungen über den Schmierzustand in der Grenzreibung," from *Forschung*, March–April, 1941. Observations of lubricating processes within the range of boundary friction on journal bearings and gear-tooth profiles strengthen the supposition that study of the attendant phenomena is possible with engineering methods and equipment. The present study is based on these conclusions which have led to the discovery of relations governing the suitability of bearing surfaces and the concept of what is known as "lubricating quality." It is concluded that in the narrow boundary layers between lubricated surfaces a peculiar state of structure of the oil films arises which gives them a quasi-crystalline property. In this state, tensile strength, compressive strength, shear strength and working capacity can be determined and correlations established in terms of engineering quantities, which are important in discussing the lubricating capacity of the tested lubricant. *N.A.C.A. T.M. No. 1014.*

## Civil Aeronautics Administration

**Portable Turntable for Large Aircraft Wins Approval.** One method of simplifying ground traffic at terminal airports, particularly the congestion near loading platforms, is the portable turntable recently developed at the C.A.A. experimental station at Indianapolis. The unit, capable of handling a Douglas DC-3, is 5 ft. 6 in. in diameter, has a 4 ft. 6 in. revolving plate and is 2 in. high. The structure, operation and application of the turntable are given in this article. *Civil Aeronautics Journal*, April 15, 1942, page 108.

**Radio Communications Section.** This section of the Federal Airways Manual of Operations contains communications operating procedure relative to emergencies and accidents. The manual outlines the procedure followed by communications personnel when pilots find themselves in difficulty, the system for transmitting information to airplanes attempting to land under adverse weather conditions, and the other instructions deemed necessary for both pilot and ground operator during emergency periods. *Federal Airways Manual of Operations*, Chapter B, Part 2, April 15, 1942.

**Altimeters.** To clarify confusion among nonair-carrier operators resulting from the amendment to Section 60.4710 of the Civil Air Regulations requiring the installation of sensitive-type altimeters, definitions are issued of three types of altimeters which can be applied for the intended kind of flight operation. This information was based on a survey conducted by the Aircraft Engineering Division and took account of the various factors that should be adhered to in the selection of the three types of altimeters.

A detailed description is given of each of the three classifications under the headings of standard, semisensitive, and sensitive altimeters. The specifications cover the required sensitivity and accuracy, the dial graduations and the mounting case. *C.A.A. Safety Regulation Release No. 106*, April, 1942.

**Inspection Handbook—Chapter XX—Aircraft Propellers.** Revised Chapter XX on aircraft propellers has been issued, superseding the edition dated September 1, 1936, and all revisions and supplements thereto except as noted in the revision. It also contains a numerical list of current aircraft engine, propeller, appliance, product and process specifications and a list of pages of Chapters XVIII and XIX revised to date. *C.A.A. Safety Regulation Release No. 108*, May, 1942.

**Carburetor Air Cleaners.** The Aircraft Engineering Division has published information to combat the difficulties that have been encountered through rapid engine wear attributed to dust and sand entering the engine through the carburetor air intake. The unsatisfactory conditions complained of principally concern aircraft equipment with four-cylinder horizontally opposed engines of 40 to 90 hp., having the carburetor air-intake scoop in the bottom forward portion of the engine cowling.

The causes of the infiltration of foreign matter are traced and suggestions are made for the use of carburetor air cleaners and a relocation of the air intake. General observations are added with respect to the two methods suggested. *C.A.A. Safety Regulation Release No. 109*, May, 1942.

**Flight Through Cumulo-Nimbus.** Paul A. Gareau. A report indicates that difficulty may arise through indiscriminate aircraft operation through cumulo-nimbus formations. The Safety Bureau points out some of the more prominent characteristics of the resultant cloudiness and reminds airmen that utmost caution must be exercised when flying through, or in the vicinity of, this type of cloud.

The bulletin goes on to describe the

appearance of the formation and the hazards of turbulence. Hail and thunderstorms are discussed and instructions are given for the path of flight during such disturbances. Recommendations are summarized, and the advice is given that if there is any possibility of doing so a flight should be detoured around such a formation or delayed. *C.A.B. Safety Bulletin No. 123*, June, 1942.

**Navy Pilot Training Program.** It has been announced that arrangements have been concluded with the Navy Department whereby 20,000 members of the Naval Reserve will be given flight instruction at Civil Aeronautics Administration pilot training centers during the coming year, contingent upon approval of appropriation estimates now under consideration.

The group will include both full-time trainees and college students taking the flight instruction on an extracurricular basis. The V-5 reservists who have been accepted by the Navy specifically for aviation duty will be given preference in filling quotas. Additional vacancies will be opened to college freshmen and sophomores signed up under the Navy V-1 plan who have indicated a preference for service in naval aviation.

Of the 20,000 reservists to receive the elementary training, 10,000 will be given C.A.A. secondary courses, and 1,500 will be selected for training as instructors. A group of 150 will be groomed as Flight Officers, popularly known as "ferry pilots," and 150 will be taught instrument flying on Link trainers. Civil Aeronautics Administration.

## British Library of Information

**Britain's War Industry Geared for Victory.** This graphic presentation shows that during the year 1941 Great Britain exported more than four times as many airplanes as were imported. The graph, which uses a silhouette of an airplane as a symbol to indicate 100 airplanes, shows that imports were approximately 2,000 airplanes and exports were approximately 9,000. It is stated that during 1942 the nation will continue to export more machines than are imported. *Bulletins From Britain*, June 3, 1942.

**The R.A.F.'s New Technique—"Hurribombing."** The British have developed a new bombing technique claimed to be more accurate than dive bombing. Hurricanes carrying bombs approach their targets at low level from over the horizon. It is said that this method of attack is extremely effective, and the bombers are virtually immune from antiaircraft fire. *War in Pictures*, February, 1942.

The Boeing AT-15 crew trainer.

**The Birth of a British Bomb.** Pictorial presentation with 16 illustrations depicting bomb production in a British factory. *War in Pictures*, February, 1942.

**Building the R.A.F.** Wing Commander Bader. A brief illustrated article describes the training of British pilots and air crews in the Dominions. *Neptune*, January, 1942.

**Old "Wellingtons" Never Die.** Pictures and brief text show how Vickers Wellingtons are returned to service within five days, repairs being facilitated by the geodetic principle of construction which localizes damage. *Neptune*, January, 1942.

**Controlling the "Halifax" Bomber.** A short description of the controls of the four-engined Handley Page Halifax heavy bomber. Illustrations show the pilot's and engineer's positions. *Neptune*, February, 1942.

## Dominion Bureau of Statistics

**Civil Aviation Statistics.** The Transportation and Public Utilities Branch of the Canadian Bureau of Statistics has issued information on civil aviation for the month of January, 1942. It gives figures on the revenue passengers carried by civil air carriers, the passenger miles, the revenue freight traffic, the mail carried, the gasoline consumption, revenues and other data bearing on the operations of civil air carriers, compared with the month of January, 1941.

## Commonwealth of Australia

**The Theory of Metallic Friction and the Role of Shearing and Ploughing.** F. P. Bowden and D. Tabor. This paper describes an attempt to place the theory of metallic friction on a more quantitative basis and to calculate the friction in terms of the known physical properties of metals. The theory states that frictional resistance is due primarily to the shearing of the metallic junctions that are formed at the points of contact and to the work of dragging or ploughing the surface irregularities of the harder metal through the softer one. An experimental investigation of these relations has been made for steel sliding on indium, this being an extremely soft metal. Commonwealth of Australia, Council for Scientific and Industrial Research, *Bulletin No. 145*, 1942.

## Australian News and Information Bureau

**What U.S. Planes Mean to Australia—49 Desperate Days.** At the outset of the Pacific War, Australia had virtually no first-line air force.

The article tells how, for a period of 49 days, the Royal Australian Air Force fought Japanese Zero fighters, using outmoded bombers and slow trainers until American airmen and combat machines were able to join them against the enemy. *Australia*, May, 1942.

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## Textbook on Gauges

This basic book on gauges and their uses in industrial inspection has been written for students of engineering, men engaged in defense training courses, and industrial engineers. It gives the theory and industrial application of dimensional control and the history of standards and gauging, and the science of measurement in modern history are reviewed in its first sections. In succeeding sections, many types of gauges, their application and operation, are described. Thread lead measurement and external and internal measurement are also dealt with. A series of tables of fits and tolerances and a chart for wear allowances and tolerances used as standard practice by plants engaged in United States ordnance production are included.

**Dimensional Control;** The Sheffield Corporation, Dayton, O., 1942; 67 pages, $1.50.

## Annual Directory

The twenty-fourth annual edition of *The Aircraft Year Book* offers a source of reference information for facts about the establishment and operation of the nation's air forces, Government departments, manufacturers of aircraft equipment, and other aeronautical agencies. Aircraft design is discussed at some length and chapters are devoted to training civil aviation airports and air-transport activities.

As usual, this standard reference book is the indispensable guide to the progress of the American aircraft industry. Each succeeding year it becomes more useful and provides a record of design, production and operation of our airplanes, engines, and accessories. The pictorial quality of the annual is always excellent.

The book is divided into two parts, the second part containing an extensive directory section. Manufacturers of aircraft, engines, components, supplies and accessories are listed.

**The Aircraft Year Book**, edited by Howard Mingos; Aeronautical Chamber of Commerce of America, Inc., New York, 1942; 693 pages, $5.00.

## Metallurgic Text

This book offers a general knowledge of the reasons metals behave as they do and is especially recommended for regular vocational, trade and technical schools and for those who are working in industry. It is also suitable for national defense training classes that offer short and elementary courses.

The contents include information on the properties of metals and tests employed to determine the uses of those metals. Chemical metallurgy is discussed, as well as the principles of physical metallurgy and the production of iron and steel. The shaping and forming of metals is another subject treated, along with the commercially important nonferrous alloys including copper and its alloys. Heat-treatments for steel and the ferrous alloys and special steels are dealt with, including surface treatments. Powder metallurgy and the classification of steels are the subjects of other chapters.

**Metallurgy,** by C. G. Johnson; American Technical Society, Chicago, 1942; 262 pages, $2.50.

## Materials Handbook

Beginning with an explanation in nontechnical language of the reasons why an airplane flies and the functions of its various parts, this handbook presents drawings and photographs of numerous military and civilian aircraft and engines, as well as their major components. The second section is devoted to the applications of steel in the construction of engines, propellers and landing gear. The third section gives specification briefs of the Army, Navy and Air Corps, and a fourth section covers steel aircraft parts and their S.A.E., A.M.S. and A.I.S.I. designations.

**Steel Aircraft Materials and Applications,** prepared by Sales Promotion Bureau, General Sales Department; Carnegie-Illinois Steel Corporation, Pittsburgh, 1942; 75 pages, $0.50.

## Aircraft Engine Finishing

This is an outline of the methods currently employed in the United States for finishing the exterior surfaces of aircraft engines and similar parts. Since the text includes a presentation of the principles on which these procedures are based, a great degree of preliminary technical knowledge on the part of the reader is not necessary. Systematic information is provided with special reference to engine-finishing problems.

Separate chapters are devoted to discussions of each of the following: purposes of engine finishing, nature of organic finishes, preparation of the metal, preparing organic finishes for immediate use, application work, and finishing systems for engines.

**Aircraft Engine & Metal Finishes,** by Myron A. Coler; Pitman Publishing Corporation, New York, 1942; 128 pages, $1.50.

## Wartime Blimps

Seeking to evaluate the potential usefulness of lighter-than-air craft to the war effort, this book relates the nature of nonrigid airships and cites the advantages that are claimed for them and what has been reasonably proved of their ability. Based on a review of the progress made in their performance, it indicates what may be expected of blimps in the future and discusses the controversial question of their vulnerability.

In support of the contention that helium-inflated airships could prove to be an effective weapon against submarines operating along the coasts, it is shown that their patrol range covers a vital area and, armed with depth bombs and machine guns, they could prove a great deterrent to enemy-placed mines as well as enemy submarines. Comparing them with airplanes, their abilities to fly low, to fly blind, to survey considerable depths of water, and even to hover in the air are presented as definite advantages for reconnaissance purposes.

**The Story of the Airship (Non-Rigid),** by Hugh Allen; The

Lakeside Press, Chicago, 1942; 74 pages, $1.00.

### Manufacturing Aircraft

This is the story of the conception and construction of the modern airplane from the drawing board and mock-up through the factory and into the air. The necessity for training, the working conditions, and the future possibilities are described. Construction of component parts, engines, propellers, and armaments are included in the illustrated sections. It describes in graphic language the planning and work required for the production of the modern airplane.

**Getting Them Into The Blue.** by Ernest K. Gann, Thomas Y. Crowell Co., 1942; 154 pages, $2.00.

### German, Italian and Japanese Airplanes

This refutation of any fallacious belief that the enemy's air equipment and organization cannot be compared with those of the Allies supplies information on individual fighters, bombers and reconnaissance airplanes being used by the Axis combatants. Separate sections are devoted to a consideration of each model's description, specifications, and performance record. Accompanying each description are photographs that help to give a comprehensive idea of what the enemy airplanes look like, what their armament is, how far they can fly, and what their fighting abilities are when pitted against the airplanes of the United Nations.

The human factor is not ignored in this record of Axis aerial resources.... account is given of the organization of the three air forces, the productive capacity of each nation, and their pilot-training programs. The entire analysis tends toward the conclusion that there is nothing second rate about the aerial strength of these enemies and, if the United Nations are to win, the ability of the foe cannot be underestimated, nor can the determination to excel them be relaxed.

**War Planes of the Axis,** by David C. Cooke; Robert M. McBride and Company, New York, 1942; 256 pages, $2.75.

### Military Aviation Album

This graphic history of the United States Army Air Forces follows the growth of American military aviation from its early stages to its present status as the backbone of the nation's war program. It relates the experimentation, progress, discouragement, and final organization of the air arm and tells of the men who sponsored it in the Army, the Government, and in industry. The personnel and training courses of the Army Air Forces are detailed and data are given on the various types of airplanes utilized.

In discussing the lessons learned from other countries, the author indicates how these lessons have been applied, the size and quality of this country's air forces, and the portended program. His evaluation of the all-over strategy of military aviation as an expected basis for victory does not neglect to point out its weaknesses.

A feature of the book is the visual presentation of its material. About two-thirds of the text is devoted to a collection of photographs that vividly interpret its contents. Rather than being confined to a merely illustrative purpose, these photographs—with explanatory captions—form a part of the narrative.

**Flying Squadrons,** by S. Paul Johnston; Duell, Sloan and Pearce, Inc., New York, 1942; 234 pages, $3.50.

### Air Transport

This survey of scheduled air transportation in and among the countries of the Pacific area was prepared in response

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to a recommendation made by the International Research Committee of the Institute of Pacific Relations in 1939. While the flexibility of its findings is necessarily controlled at present by military events, it provides a basis for determining the course of future developments in air transport by suggesting the principles upon which these services depend. The air-line systems in the Pacific region are described as they existed at the time the report was written and an analysis is made of the factors affecting them.

In addition to the general observations and conclusions regarding air transport, specific data are given on its development in each of the following countries: The Union of Soviet Socialist Republics; Japan; Manchuria; China; Thailand; British, French, and Dutch colonies in the Pacific Ocean; Australia; New Zealand; Canada; United States; Mexico; Central America; and the countries on the west coast of South America.

**Air Transport in the Pacific Area,** by Sydney Bernard Smith; International Secretariat, Institute of Pacific Relations, New York, 1942; 120 pages, $1.00.

## Celestial Navigation

Prepared mainly for use in surface navigation, this manual has several distinctive features, including methods for working sights and plotting lines of position from both assumed and dead reckoning positions. It has no interpolation and a new azimuth rule has removed the ambiguity from the solution for azimuth from an assumed position. Short, simple and uniform solutions are provided under all conditions. The manual has been arranged primarily to facilitate the solution of the problem of computed data for lines of position. Table I is arranged in columns of latitude across the pages to bring all of the data for one latitude together on two adjacent pages. Table II is unchanged from a previous method of navigation prepared by the author, which has been published in *Hydrographic Office Publication 211* and which is reproduced in this manual by permission of the Hydrographic Office of the United States Navy.

**Manual of Celestial Navigation,** by Arthur A. Ageton; D. Van Nostrand Company, Inc., New York, 1942; 103 pages, $1.85.

## Italian Aircraft

*Basic Field Manual FM 30–39*, published in 1941 under restrictions, has recently been released. It contains photographs, three-view and four-view drawings and specifications, where available, on numerous types of Italian military aircraft. Under the heading of landplanes, information is given on twelve fighters, two fighter bombers, ten bombers, two reconnaissance airplanes, three army cooperation airplanes, six transports and two general purpose airplanes.

Under the heading of "Seaplanes," similar information is given on two fighters and four reconnaissance bombers.

The specifications are tabulated under headings of general description: crew, armament, ammunition, bomb load, radio, armor, engines, maximum speed, rate of climb, service ceiling, range and wing span.

**Basic Field Manual—Military Intelligence—Identification of Italian Aircraft,** prepared under the direction of the Chief of Staff; United States Government Printing Office, Washington, 1941; 91 pages, $0.15.

## Effects of War

Surveying the effects of the war upon the economic and industrial lives of the American people, this is a discussion of the probable changes in their pattern of civilization now and after the war. Among the current problems it covers are: the millions of men in the armed forces and those in war industries; the sudden rapid growth of communities around war plants; the pressure upon farmers for produce; the housing boom; the overwhelming expansion of infant industries; and the high national income. Some of the questions considered are whether this nation is heading for another depression after the War, what are the chances of keeping factories in production and workers employed, and whether the country can maintain a high national income.

**Arms and the People,** by Alden Stevens; Harper & Brothers, New York, 1942; 262 pages, $2.75.

## Air-Transport Policies

In a study of the political and economic implications of international air transportation, the author acknowledges the growing commercial significance of air services between countries but contends that their chief significance lies in their political and military importance. Legislation with regard to international air routes, he claims, is not based on monetary considerations so much as upon questions of national prestige and diplomatic advantage.

Examining the various relations between governments and international air-transport enterprises, the book reviews the political history of air transportation. The factors influencing national policies in the past are identified, as well as the obstacles that may limit the development of air services in the future. Freedom of commercial intercourse is defined as the natural order and the study is directed toward the principle that air transportation should be the result of collective planning for collective welfare.

**International Air Transport and National Policy,** by Oliver J. Lissitzyn; Council on Foreign Relations, New York, 1942; 478 pages, $5.00.

## Use of Flight Films

For guidance in the use of the instructional sound films *Theory of Flight* and *Problems of Flight*, this manual outlines the general procedure for obtaining the maximum educational value from the films. Besides describing each film and making objective the abstract concepts involved in the study of flight, it supplies supplementary information helpful to the demonstrator in answering questions.

In the film *Theory of Flight*, the forces acting on plain and cambered airfoils are described. The control of an airplane with rudder, elevator and ailerons is demonstrated, and pitching, rolling, and yawing are depicted under actual flight conditions.

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*Problems of Flight* shows the use of the airplane's controls in taking off, climbing, banking, stalling, spinning and recovery, diving, gliding and landing.

**Aerodynamics,** by James A. Brill and H. A. Gray; The University of Chicago Press, Chicago, 1942; 36 pages, $0.15.

## West Point of the Air

Second in the Service Academy Series on United States Officer Training Schools, this is a history of Randolph Field and an account of the basic training given to candidate officers for the United States Army Air Forces. In recounting the origination and growth of Randolph Field, the progress of military aviation in the United States is traced from its beginning with one airplane in the Signal Corps to the present complex organization of the Air Forces.

The many phases of life at Randolph Field are portrayed from the time an aviation cadet enters training until the day when he is graduated....his instruction on the ground and in the air, his recreations, his discipline, his humor and his slang. This book also tells of the men who teach these flyers and of the mechanics who keep them safely flying. While dealing specifically with Randolph Field, it tells of basic training methods that are applicable to all similar training centers in the United States.

**Randolph Field; A History and Guide,** compiled by the Texas W.P.A. Writers' Project; The Devin-Adair Company, New York, 1942; 156 pages, $2.00.

## Welding Training

Prepared primarily to assist instructors in planning courses for the training of oxyacetylene welding and cutting operators, the contents of this manual are presented in outline form. The first part outlines information to be presented in training courses for general welding operators, aircraft-welding operators, and pipe-welding operators. The second part offers material for the training of various types of cutting operators. Part three is a guide for instructing in an inspectors' course; it also specifies the primary requirements for students who take this course.

The material presented has been divided into self-contained units. Each of these units contains an outline for a classroom lecture, suggestions for study assignments, recommendations of subject matter to be demonstrated and discussed, and a description of the practice exercises that should be done in the shop. Recommendations for qualitative testing of the students' work are included.

**Training Oxy-Acetylene Welding and Cutting Operators,** compiled and presented by the Oxy-Acetylene Committee; International Acetylene Association, New York, 1942; 88 pages, $0.25.

# Book Notes

**Man With Wings,** by Joseph Cottler; Little, Brown and Company, Boston, 1941; 257 pages, $2.50.

Concentrating on his ability as an inventor rather than a painter, this biography of Leonardo da Vinci portrays his study of aeronautics and his prophetic work in the field of flight. An account is given of other results of his brilliance applied to mechanics which had their effect on modern warfare, such as his experimental designs for armored tanks, machine guns, battleships and diving suits.

**Million-Miler,** by John R. Tunis; Julian Messner, Inc., New York, 1942; 253 pages, $2.50.

With over a million miles to his piloting credit since 1929, the story of Jack Zimmerman, Chief Pilot of the Atlantic Division of Transcontinental and Western Air, Inc., runs almost parallel with the development of commercial aviation since that time. He flew one of the first trimotored Ford airplanes, took up the first DC-I, piloted the first scheduled flight into New York's La Guardia Field, and was at the controls of the Boeing Stratoliner which set a transcontinental record for a scheduled transport flight on its inaugural trip. This biography describes Zimmerman's career from his boyhood in Ohio to his achievements as a top-flight pilot.

**Sea Power in Conflict,** by Paul Schubert; Coward-McCann, Inc., New York, 1942; 252 pages, $2.50.

In this study of naval warfare from 1939 to 1941, attention is directed to capital ships, submarines, and airplanes. Terminating with the Japanese attacks on the Philippines and Hawaii, important naval battles are recounted and the strength of conflicting navies is assessed.

**The Air Raid Warden in America,** by Jordan W. Lambert; Hastings House, New York, 1942; 57 pages, $1.00.

This basic training manual for air-raid wardens defines the duties of wardens, lists the precautions to be taken against raids, and gives information on various destructive agents. Mention of equipment or materials is confined to articles that can usually be found in homes or places of business. Emphasis is placed on the relations of air-raid wardens with the public and their cooperation with other civil defense organizations.

**Armies on Wheels,** by S. L. A. Marshall; William Morrow & Company, New York, 1941; 242 pages, $2.50.

A study of the significant campaigns since Dunkirk, with emphasis on what they teach about the "ideal army" for an offensive and defensive war.

**American Road Builders' Association, Convention Proceedings 1941;** American Road Builders' Association, Washington, D. C., 1941; 819 pages, $10.

Papers presented at the thirty-eighth annual convention of the association, held at New York on January 27–31, 1941, classified according to the different sessions at which they were presented.

**Aircraft Engine Drafting Room Practice;** Society of Automotive Engineers, Inc., New York, 1941; 37 pages, loose-leaf form, $1.50.

This manual includes, among other items, data on the preparation of a mechanical drawing, dimensioning, lettering, and arrangement. Dimensioning by the decimal system is an important new method described. Included is a sheet of abbreviations and symbols.

**S.A.E. Aeronautical Standards;** Society of Automotive Engineers, Inc., New York, 1941; 78 pages, loose-leaf form, $1.20.

A complete set of 42 separate aircraft-engine standards, including carburetor control connections, carburetor flanges, propeller shaft ends, tachometer drives, magnetos, screw heads, bolt heads and others, as well as standard definitions and symbols.

**Thoughts Through Space,** by Sir Hubert Wilkins and Harold Sherman; Creative Age Press, Inc., New York, 1942; 421 pages, $4.50.

A documented account of a protracted experiment in telepathy between an Arctic explorer and his "receiver" in New York. Reports, messages, sworn statements of researchers and observers, and methods employed are detailed. The book also describes the Wilkins' Arctic expedition, requiring airplane flights totaling more than 44,000 miles, and the search that followed when the fliers were lost.

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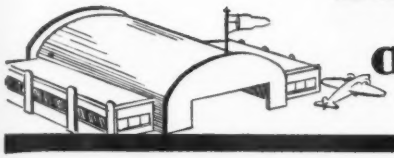
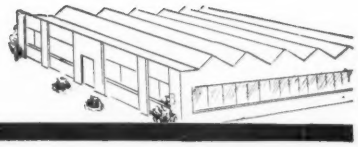




### Flying Battleship

*Nerve Center of Mars.* A brief description and some statistics have been released on the Martin Mars, the largest aircraft in the world. The flight deck, or bridge, is said to compare in size with the bridge of a surface vessel, being actually larger than the interior of a 21-passenger airliner and having accommodations for the captain, the pilots, the navigators, the radio operator and the engineer officer. Passageways lead from the bridge to other rooms providing quarters for the officers and crew, the auxiliary engine room in which power is generated for the airplane's control equipment, lighting, cooking and ventilation, and through the wings to the four-engine nacelles. The latter, each housing a 2,000-hp. engine, are large enough to allow space for a mechanic to sit while watching the operation of the engine and to perform necessary repair work in flight. The routine and discipline prevailing during the operation of the great seaplane are likened to those on a surface ship of the Navy. *The Martin Star*, May.

### Catalogue Additions

Additions and revisions for the Kollsman Instrument catalogue have been issued. A new section has been added, covering a new type of high-range air-speed indicator, and revised sections include those on accelerometers, compasses, manifold pressure gauges, drag cup motors, suction gauges and teletorque (remote indicators). *Kollsman Instrument Division of Square D Company.*

### Aircraft Production Progress

*Aircraft Industry's Production Lines —Bulwarks of U.S. Offensive Action.* How the aircraft industry has performed a miracle in production is related. Without revealing figures, it is shown that the industry has more than met the challenge of actual war conditions by increasing its output tremendously while maintaining the most rigid standards of precision manufacture. It is said that the aircraft industry was not only ready to assume the task of heavy production for war but was willing to turn over to the automobile industry certain designs and the benefits of its skill and experience. The technical superiority of United States aircraft has been commented upon by military leaders and the praises by Gen. H. H. Arnold are quoted. The contributions of products of United Aircraft are noted. *The Bee-Hive*, May.

### Scrap Conservation

*Scrapping's Their Job!* Methods followed in the Bell Aircraft plant for the salvaging of scrap are described and illustrated. One example given of the work of the Scrap Department is the salvaging of over 200 gal. of mineral oil each day through the centrifugal "drying" of all types of cuttings machined with oil. *The Bellringer*, May.

### Suggestion Box Winners

*Ideas for the Allies.* An outline of the system instituted by the Boeing Aircraft Company in accordance with the suggestion made by the War Production Board for the consideration of production-improvement ideas submitted by employees. Ten winning ideas are also listed. *Boeing News*, May.

### Portable Landing Strips

*Another Addition to Our New Air Force.* Methods used by the United States Army for rapidly constructing portable air fields are described and illustrated by photographs supplied by the U.S. Army Signal Corps. How the individual steel panels, each 10 ft. long, 15 in. wide and 1/8 in. thick, are laid, fastened together and tested is detailed. Emphasis is placed on the speed with which a smooth landing surface can be provided over rough ground that would otherwise be impossible to use. *The Exchangite*, May.

### High-Altitude Laboratories

*Stratosphere at Sea-Level.* Simulating high-altitude conditions, the Douglas cold-room laboratory affords an opportunity of accustoming men to the stratosphere. The High-Altitude Training Program is described, whereby U.S. Army men and officers are taught how to cope with the sub-Arctic cold and almost oxygenless air. In explaining the limitation of this training program to four hours a day because the laboratory is needed the remainder of the time for structural experimentation, it is stated that one of the principal reasons for Hitler's failure in Russia last winter was the effects of the cold weather—unanticipated by his engineers—on the controls, hydraulic lines, rubber connections and other functional parts of his airplanes.

Experimentation in the cold laboratory is also credited with having pushed up the ceiling of airplanes about 5,000 ft. within the past six months, with the belief expressed that within the next year the ceiling will be raised considerably higher. *Douglas Airview*, April.

### Lighting Manual

A new lighting manual to meet the need for recent data on the use of lighting as a tool in solving the problems of production, rejects, employee fatigue, accidents and morale, greater utilization of floor area, windowless plants, 24-hour operation and others has been published by the Benjamin Electric Manufacturing Company, Des Plaines, Ill.

The main section of the guide is devoted to the solutions for the 21 lighting problems most commonly encountered in plants converting to war production. These solutions are written in nontechnical language and are illustrated by means of diagrams and layouts.

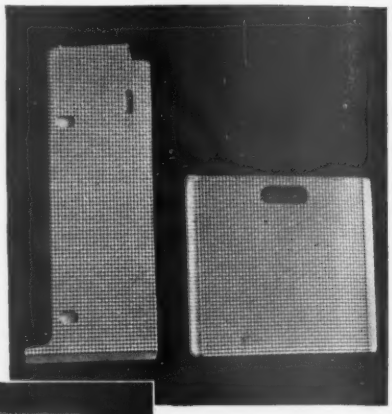
The problems include those dealing with the proper use of such equipment as fluorescent lighting for general illumination, for close color matching, for inspection, and incandescent lighting with fixtures for general and special lighting applications.

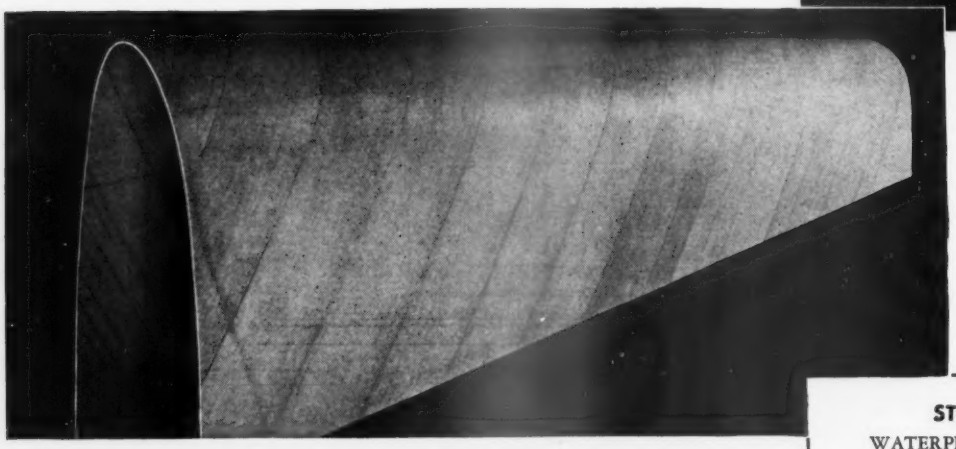
### Military Air Cargo

*Freighters of the Sky.* A development in the use of air power which has received less attention than the production and use of combat aircraft is the progress that has been made in designing and building aircraft for carrying military cargo. This article shows that the delivery of completed airplanes through the Air Forces Ferry Command paved the way for the use of aircraft as freight transports. Some figures are given on the capacity of present and

# 3 Ways to utilize WELDWOOD* Construction . . .

*U. S. Plywood experience and facilities can help you simplify and speed production*





*Transport or Bomber floors of special metal-covered Weldwood.*

*U. S. Plywood Corp. has been designing and building such floors for leading aircraft manufacturers for the past seven years.*

*Molded Weldwood Leading Edge. Length 12' 9". Chord at root 31½", at outboard tip 18".*

Aircraft engineers already know that phenolic resin bonded Waterproof Aircraft WELDWOOD . . . strong, light, rotproof...makes possible greatly improved construction at economical cost. But do *you* know that this strong, durable material is also available in Molded form and Fabricated parts, as illustrated?

Back of these three proven WELDWOOD products are the greatest experience and facilities to be found in the industry:

1. Complete logging, veneer cutting and manufacturing facilities . . . including the largest hardwood plywood plant in the country.
2. Years of experience producing hundreds of Molded† WELDWOOD boat hulls, station wagon tops and other products...and two plants now producing exclusively Molded WELDWOOD tabs, ailerons, ducts, control surfaces, fuselages, etc.
3. A Fabricated Parts plant producing floor boards, partitions, navigators' tables, wing tips, and other items for aircraft.

All of these facilities are placed at the disposal of the Aircraft Industry . . . as also are the services of a qualified technical staff which includes engineers, chemists, and wood technologists. Write today for illustrated booklet and complete information.

†Made by the Vidal Process U. S. Pat. No. 2073290.

## STOCK LIST

WATERPROOF AIRCRAFT WELDWOOD

48" x 96" 48" x 84" 48" x 72"

BIRCH (Birch Core)

1/32"—3 ply

BIRCH (Poplar Core)

| | |
|---|---|
| 1/16"—3 ply | 3/16"—3 ply |
| 3/32"—3 ply | 1/4" —5 ply |
| 1/8" —3 ply | 5/16"—5 ply |
| 5/32"—3 ply | 3/8" —5 ply |

1/2"—7 ply

MAHOGANY (Poplar Core)

| | |
|---|---|
| 1/16"—3 ply | 3/16"—3 ply |
| 3/32"—3 ply | 1/4" —5 ply |
| 1/8" —3 ply | 5/16"—5 ply |
| 5/32"—3 ply | 3/8" —5 ply |

1/2"—7 ply

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## New Plastic Glue proves its worth in Uncle Sam's Boats and Planes‡

WELDWOOD *plastic resin* WATERPROOF Glue makes strong, permanent joints, highly resistant to heat, moisture and salt water. Stronger than wood it fastens . . . absolutely impervious to bacteria and rot. Available in 100 lb. drums and smaller containers.

Write today for literature and FREE sample can.

‡APPROVED for aircraft by U. S. Army, U. S. Navy and Civil Aeronautics Authority when properly applied.

**"MAKES THE GLUE LINE THE SAFETY LINE"**

## Wood's Good— WELDWOOD Is Better!

*Family name of plywood products made by the United States Plywood Corporation

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WORLD'S LARGEST PRODUCER OF PLYWOOD

Branch Offices and Warehouses in Baltimore, Boston, Brooklyn, Chicago, Cincinnati, Cleveland, Detroit, High Point, Los Angeles, Newark, New York, Philadelphia, Rochester, San Francisco, Seattle.

projected cargo aircraft in which nonstrategic materials are being used. An important factor in the development of large cargo-carrying airplanes is the perfection of large engines such as those built by Wright Aeronautical Corporation. *Trade Winds*, June.

### Women War Workers

*With the Women.* In a report on the activities of women in the Douglas factories, the more unusual jobs are high-lighted. An engineer, a tool designer, and a liaison worker in the inspection department are among the more specialized jobs that have been assumed by women, with highly successful results. *Douglas Airview*, April.

### Bombing Flight

*Bombs Away.* Pictures and brief descriptive matter give an indication of the work of the men who fly bombing airplanes and of the important part played in this work by the instruments used. *The Kollsman Instrument Dial.*

### Failures in Service

*The Why of Structural Stresses and Failures.* F. R. Shanley. A description is given in nontechnical language of some of the stresses encountered by the parts of airplanes. The stresses of vibration, fatigue and impact are explained, and examples are given. *Lockheed Aircraftsman*, May.

### Cowl Fastener Catalogue

The Aviation Division of Shakeproof, Inc., has issued catalogue AD-1 giving engineering and procurement data on Shakeproof cowl fasteners. Various models of these fasteners are depicted, with descriptive data and reproductions of drawings and graphs giving test results for various parts of the fasteners. Specifications are tabulated. Tools and accessories are also covered and special products for aircraft use are included. *Shakeproof, Inc.*, Chicago, Ill.

### Engineering Standards Pages

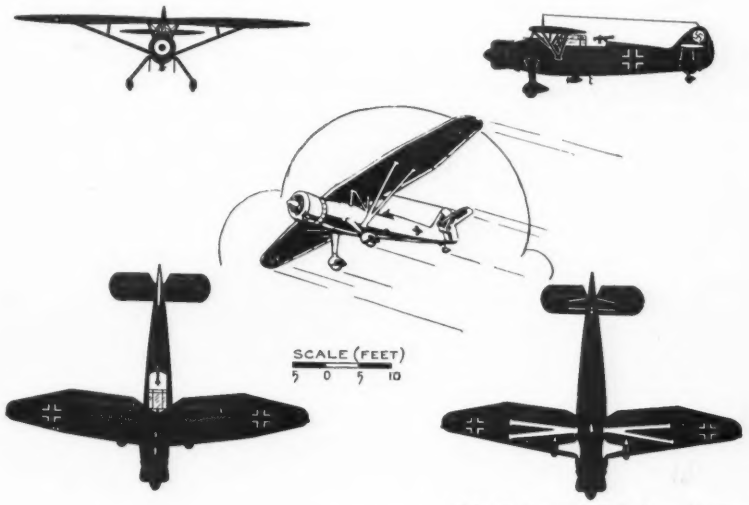
A new set of engineering standards pages has been issued for the *Speed Nuts For Aircraft* catalogue issued by Tinnerman Products, Inc. These pages supersede all engineering pages now in the catalogue and are to be inserted in the place of the outdated ones. Many new parts have been added since publication of the catalogue in July, 1941, and new devices are included to speed up production and reduce weight and assembly costs.

### Flutter Tests

*"Shake & Shudder" Boys Feel Mars' Pulse.* Techniques and tools used by the vibration engineers at The Glenn L. Martin Company's plants are explained briefly. The use of the flutter detector, a small instrument placed on a surface where vibrations may occur, is explained. It is connected to an oscillograph and shows where vibrations are building up to a critical point. These devices are used to supplement and facilitate the work of aerodynamicists and stress engineers and are applied for many other purposes in addition to testing surface vibrations. *The Martin Star*, June.

### Radio in War

*Radio All-Out For Victory.* Radio Corporation of America has issued a brochure detailing the contributions of radio to the Navy's war effort. It shows the numerous applications of radio in practically all military and defense operations and devoted several pages to the use of radio in connection with aircraft. *Radio Corporation of America.*




*Official photograph U.S. Army Air Corps.*

Henschel Hs 126.

### Straightening Problems

A straightening press for use on jobs involving large numbers of identical parts has recently been placed in service at the plant of the Lindberg Steel Treating Company. The press permits the operator to exert pressure on the part to be straightened and immediately observe the action, without the necessity of removing the part. Parts up to $^3/_4$ in. diameter may be straightened. The construction of the press and the procedure in using it are described. *Lindberg Engineering Company.*

### Test Pilots

*The Sky's Their Limit!* The duties of test pilots of the Bell Aircraft Corporation are recounted. The test pilots gather performance data and then analyze it with the assistance of other members of the flight research staff. The responsibilities placed on these men are said to be great and to have much to do with the maintenance of the reputation of Airacobra. *The Bellringer*, June.

### Gliding

*Flight By Glider.* Capt. J. Shelly Charles. The various types of gliders are discussed by a former American Open Soaring Champion. Some of the early and more recent records are mentioned. The value of gliding as a primary training medium for pilots is briefly discussed. *The Great Silver Fleet News*, Spring Edition.

### Plastics

*Synthetic Resins for Coatings.* A simplified classification has been compiled to indicate the types of Bakelite resins and the uses to which they are put in the paint and varnish industry. *Bakelite Review*, April.

### New Plant

*A New Neighbor for the Hermitage.* The establishment of the plant of Vultee Aircraft, Inc., at Nashville, Tenn., is described and illustrated with views of the interior. *Vultair*, April.

### Machine Lubrication

*We Ride the Thunderbolt.* Jay Madison. Reviewing briefly the history and accomplishments of Republic Aviation Corporation and its contributions to the equipment of the Army Air Corps, this article gives brief information on some of the manufacturing processes followed at the Republic plant and a description of some of the machines and instruments used. Throughout the article the importance of the correct lubricant for different types of machinery and equipment is stressed. *Shell Progress*, May.

### Instrument Manufacture

*How Instruments Are Made.* Article No. I of a series about the different steps in making aircraft instruments tells how the creation of an instrument is started, how the idea is sketched and then developed in the drafting room. Later installments in the series will take up other departments and will show how the instrument is manufactured, assembled and tested. Photographs show the steps through which a new design moves. *The Kollsman Instrument Dial.*

### Saving Man-Hours

*Ideas Can Win the War.* In keeping with suggestions outlined by the War Production Board, the Douglas California plants have instituted a system of acquainting employees in each department with details of the production drive, helping them to develop and prepare ideas for presentation as shop suggestions, and putting into action new ideas for increased production. It is claimed that 500 of these ideas applied to production have resulted in an improvement of 730,000 man-hours per year.

One of the winning awards was for the development of a felt pressing form to replace an operation formerly done by hand. Another was for an idea that increased the hardness of master plaster patterns for greater longevity. A third winning suggestion was for a faster, safer check of fuel lines which increased the amount of fuel system under pressure by 50 per cent. *Douglas Airview*, April.

### Painting Short Cut

*Mechanical Painter.* A robot painter that sprays automatically the multitude of parts essential to Martin bombers has been installed by The Glenn L. Martin Company. Operated by five men, the device does in a third of the time the work that formerly required fifteen men. Ten men needed for other work thus are released from hand-operated spray guns. The machine was made for Martin by a spray-gun manufacturer, but numerous refinements and improvements have been added to adapt it to aircraft work. One of these is a ventilator arrangement that removes excess particles of paint which are filtered through a spray of water and retrieved. Other processes in the use of the painting machine are described. *The Martin Star*, June.

### Tin Bronze Specifications

Another of a series of data sheets published by Ampco Metal, Inc., gives information on alternate specifications for tin bronze, showing applications where substitutes may be employed. The properties of suggested substitutes are discussed and a tabulation is presented of the normal composition and physical properties of copper base alloys. *Ampco Metal, Inc.*, Milwaukee, Wis.

### Inventory Control

*45 Day Inventory Turnover.* Methods of inventory control are treated in narrative form which show how Vultee has succeeded in coordinating the capacity of its advanced plant facilities and equipment to such an extent that a reduction of 60 per cent has been made in its demands for raw material on parts on the nation's supply of scarce aircraft materials. *Vultair*, April.

### Industry Statistics

A study of the combined net income of groups of industries for the year 1941 compared with 1940 shows that 34 companies in the aircraft and parts industry had combined net income of $90,691,000, a gain of 64.5 per cent over the $55,118,000 reported for 1940. This compares with a gain of 22.3 per cent for the entire transportation equipment group, which includes such industries as automobiles, railway equipment and shipbuilding.

The air transportation industry, represented by 13 companies, had a reported combined net income of $3,904,-

"STANDARD Products—Standard for the Industry"
STANDAIR
PARTS
Suppliers to the U. S. Army Air Corps—to the Royal Canadian Air Force—to the British Royal Air Force—and to leading American aircraft manufacturers.
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WANTED
ENGINEERS, DRAFTSMEN and CHECKERS
for design and development of aircraft apparatus of Electro-mechanical type.
Experience on mechanisms, gearing, and precision work desired.
Applicants not presently employed on defense work send complete resume to
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000, a decline of 17 per cent from the 1940 figure of $4,703,000. The transportation group as a whole, represented by 231 companies including railroad, traction and bus, shipping and miscellaneous transportation, gained under the influence of a sharp upturn in railroad and shipping earnings. *Bulletin of The National City Bank of New York*, April.

### Plastic Data Sheets

Data sheets issued by the Rohm & Haas Company set forth the physical properties of Plexiglas and describe the methods and apparatus used in testing it for cold-flow and weathering. Six graphs present the results of tests under varying conditions. It is recommended by the manufacturers that until additional data can be obtained a design limit of 1,000 lbs. per sq.in. be established for any structural or semi-structural applications of Plexiglas subjected to long outdoor service. *Rohm & Haas Company.*

### Lock Nuts

An-cor-lox Division of Laminated Shim Company has issued a folder describing the features and applications of An-cor-lox nuts, instructions for their application and suggestions for conversion of mechanical devices for the use of this style of lock nut. The nut itself is of all-metal construction, self-contained, and is devised for locking security, speed and ease in application. The nuts are re-usable and can be made in a full range of sizes and metallic alloys to meet varying conditions of corrosion, heat, strength and other factors. *An-cor-lox Division of Laminated Shim Company, Inc.*, Glenbrook, Conn.

### Douglas Torpedo and Dive Bombers

*Mid-Pacific Offensive.* Frederic C. Coonradt. Introduced by an account of their participation in Pacific naval battles, this is a report of the commendation accorded the combat performances of Douglas bombers by the Navy, the Army, and the Marines. The principles of both dive bombing and torpedo bombing are explained, with particular reference to the mechanical construction and operation of the Douglas dive bomber (the Dauntless) and the Douglas torpedo bomber (the Devastator). *Douglas Airview*, April.

### Aircraft Finishes

A recent booklet entitled *Wings of Victory*, published by Berry Brothers, manufacturers of aircraft finishes and other types of paints and varnishes, contains brief outlines of Army and Navy aviation units, silhouettes of important aircraft types used by the United Nations and the enemy, and a set of pictures of the insignia used to identify the various aircraft squadrons of the Army, Navy and Marine Corps. Colored photographs of several combat, trainer and commercial types of aircraft serve to illustrate the application of the company's products. *Berry Brothers, Inc.*, Detroit, Mich.

### Adhesives Tabulation

The principal characteristics and methods of handling plywood adhesives are tabulated in convenient form for ready reference. The two-page table was compiled with the cooperation of the United States Forest Products Laboratory at Madison, Wis. *Bakelite Review*, April.

### Quality Control

*Hair Splitters.* The use of scientific instruments of great accuracy and delicate adjustment is explained in an article which shows the rigid standards insisted upon by quality control inspectors at the Wright Aeronautical Corporation. Precision instruments that measure to the millionth part of an inch are used regularly by these inspectors who guard the quality and precision of aircraft engine parts. The profilometer, the visual gauge, the comparator and other instruments are described, along with the techniques employed. *Trade Winds*, June.

### Fleet-Fillet Welding

The "Fleet-Fillet" technique of arc welding, which permits faster production of welded ships, tanks, guns and other war products, is described and illustrated in a new bulletin just published by The Lincoln Electric Company, Cleveland, O. It contains 18 pages and 36 illustrations, including photos and line drawings.

"Fleet-Fillet" technique is said to make possible faster weld production without increasing operator fatigue, reduction in amount of welding electrode per foot of weld, and lower welding costs. Text explanation, photos and sketches compare the "Fleet-Fillet" and conventional techniques as regards angle of electrode, weld penetration, weld strength, deposited metal and speed of welding, for both single- and multiple-pass welds. It is claimed that an arc speed of 65 ft. per hour can be maintained for welding a $^3/_8$-in. horizontal fillet, compared with 30 ft. per hour using conventional procedure. *The Lincoln Electric Company*, Cleveland, O.

### Ball Bearing Maintenance Manual

A new manual on *Handling, Installing and Overhauling Ball Bearings in Aircraft Control Systems* has been issued by The Fafnir Bearing Company, New Britain, Conn. It contains practical directions for handling ball bearings in the stockroom, mounting ball bearings, bearing inspection and trouble shooting, inspection and overhauling of bearings, bearing pullers, relubricating procedure and relubricating fixtures. Sketches and drawings illustrate the text. *The Fafnir Bearing Company.*

### Arctic Air Service

*Air Line to the Arctic.* Peter Elliott. The establishment and operation of the Mackenzie Air Service, Ltd., are outlined, with information on the vast new territory that was made accessible by the establishment of this service. Difficulties encountered and some outstanding services performed are detailed and the illustrations show some of the extraordinary cargoes transported. *The Intava World*, March.

### Precision Handbook

The Leeds & Northrup Company has issued a publication of general interest to engineers, research scientists, executives and users of electrical instruments, controls and furnaces. Called *Modern Precision*, it contains information on instruments, controls and heat-treating methods and of the jobs they are doing in industry, in research laboratories and in teaching and testing. It supplements the company's regular catalogues, bulletins and circulars which will continue to be issued as before.

The company has also recently issued its *Catalogue No. N-28-160* covering the Centrimax Flowmeter for steam and water, which describes the construction, operation and application of these instruments. *Leeds & Northrop Company.*

### Booklet on Finishes

A booklet on United States Government Specification Finishes has been published by Maas & Waldstein Company. The booklet provides makers of armament products with essential information on M&W finishes that have been made to conform with various United States Government specifications. *Maas & Waldstein Company*, Newark, N.J.

### Communications Equipment

Some of the contributions of the Western Electric Company to the nation's war effort are pictured and briefly described together with some of the many applications in which the company's products play a part. These range all the way from delicate radio equipment for aircraft to the signal and communications systems on destroyers and battleships. *Western Electric Pick-Ups*, May.

### Gauge Block

*The Care of Gage Blocks.* A four-page booklet reprinted from *Tool and Die*

*Journal* for February, 1942, is offered by the George Scherr Company to aid in the proper care and maintenance of gauge blocks. Pertinent information is also included on methods of increasing the usefulness and life of these precision instruments. *George Scherr Company, Inc.*, New York.

### Development History

*The Development of Bristol All-Metal Aircraft.* The history and evolution of the products of the Bristol Aeroplane Company, Ltd., is traced in considerable detail. It is said that that company was the first British organization to institute research leading to the development of aircraft of all-metal stressed-skin construction. Illustrations show the progress made in the design of these airplanes from the Bristol 142 to the Bristol 156, known as the Beaufighter. *The Intava World*, March.

### Engineering Standards

Part 2 of its engineering service handbook has been issued by the New Departure Division of General Motors and gives details of design of shafts and housings for ball bearings. Drawings and explanations are presented to show correct practice in the applications of ball bearings. The information is divided into two sections—the first gives details on the installation of shafting; the second, on housings. Tabulations are presented showing the various dimensions for standard bearings and housings as well as information on the selection of equipment for use with the bearings. *New Departure Division of General Motors Corporation.*

### Conveyor Belt for Subassemblies

*Production Plus.* Increased output, decreased spoilage, and more effective use of working time and energy are the advantages claimed for the new moving belt conveyor for subassemblies which has been installed in the Santa Monica plant of the Douglas Aircraft Company. This article describes the construction of the conveyor; tells how the physical layout of the plant was made to conform with the reception of materials from the mechanized line; and explains how the operation of the belt is timed so that each part arrives at the right working position at the right moment. *Douglas Airview*, April.

### Weldwood Booklet

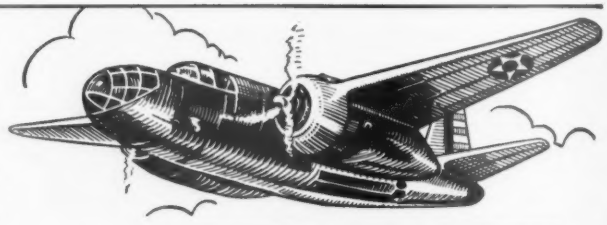
A new folder issued by United States Plywood Corporation describes and illustrates a number of major aircraft parts now being made of plywood molded with synthetic resins into compound forms. These include flaps made of molded weldwood, wing tips, pilots' seats and a complete fuselage as well as wing leading edges, supercharger ducts, tubes and other special shapes.

The application of weldwood to industries other than aircraft is also covered in the booklet, including parts for patrol torpedo boats and landing boats. *United States Plywood Corp.*

### Adhesives Booklet

A technical service manual has been issued under the title *"Fairprene" Cement, a New Industrial Adhesive*, which describes "Fairprene" cements and caulking compounds. These are unvulcanized synthetic elastic compositions dispersed in a suitable solvent which contain either the necessary ingredients for vulcanization with heat or are so formulated that vulcanization will take place at atmospheric temperatures with the addition of a solution of activating ingredients. The seven grades of "Fairprene" cements and caulking compounds are discussed, together with their physical properties, vulcanization, permeability to gases, resistance to oils and chemicals, some industrial applications, how they are applied and special instructions. These materials are used in sheet metal joints of aluminum and aluminum alloys preparatory to riveting in the fabrication of various products and also have numerous other uses. *E. I. du Pont de Nemours & Company, Inc.*


# How much GOLD in a bomber?



**The little there is does a vital job . . . perhaps there should be more**

Delicate electrical contacts in instruments for war planes are now being made from a Ney Gold alloy which combines desirable electrical and service characteristics with susceptibility to precise control of hardening. Another Ney alloy is being used for precision instrument bearings.

Perhaps you, too, have been looking for a solution to similar problems. Study this condensed chart of physical properties for standard Ney alloys. Then consult our Research Department, generally acknowledged as the most experienced and completely equipped in the country devoted to precious metal metallurgy.

**WHAT IS YOUR PROBLEM?**

Existing Ney Gold alloys offer the following broad range in physical properties:

Brinell Hardness 30 to 300
Tensile Strength . . . up to 200,000 p.s.i.
Elongation up to 40%
Modulus of elasticity 12 to 18,000,000 p.s.i.
Specific gravity 11 to 18 gm/cc
Melting temperature 1500° to 2800° F

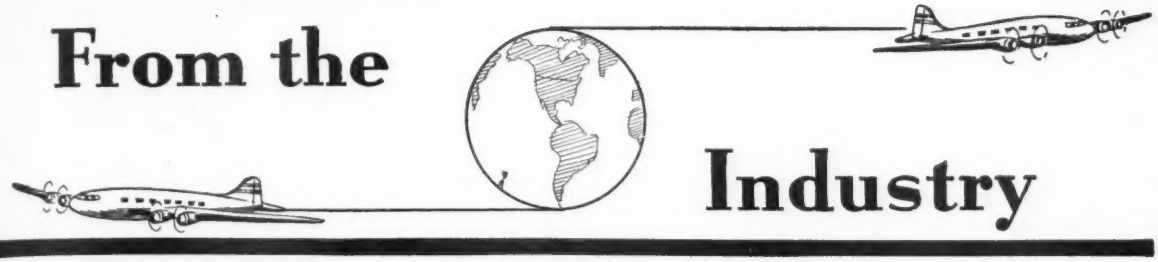
Typical alloys are non-corrosive and hardenable by heat treatment. Can be soldered, welded, drawn, rolled, stamped, swaged or machined.

THE J. M. NEY COMPANY HARTFORD, CONNECTICUT

| FUSION TEMPERATURE °F. | BRINELL HARDNESS | | % ELONGATION | | ALLOYS | PROPORTIONAL LIMIT p.s.i. | | ULTIMATE TENSILE STRENGTH p.s.i. | |
|---|---|---|---|---|---|---|---|---|---|
| | Annealed | Heat Treated | Annealed | Heat Treated | | Annealed | Heat Treated | Annealed | Heat Treated |
| 1925 | 190 | 270 | 15 | 7 | Ney Oro #4 | 86,500 | 131,500 | 117,500 | 173,000 |
| 2010 | 175 | 275 | 20 | 15 | Ney Oro #12 | 88,000 | 135,000 | 125,000 | 178,000 |
| 1675 | 200 | 290 | 14 | 1 | Ney Oro G-C | 73,000 | 135,000 | 120,000 | 165,000 |
| 1750 | 170 | 280 | 27 | 6 | Ney Oro G | 77,000 | 154,000 | 99,000 | 160,000 |
| 1975 | 225 | 260 | 9 | 8 | Neydium #9 | 115,000 | 134,000 | 148,000 | 167,000 |
| 1970 | 150 | 270 | 24 | 15 | Paliney #6 | 63,500 | 127,000 | 110,000 | 170,000 |
| 1985 | 180 | 280 | 24 | 9 | Paliney #7 | 89,000 | 148,000 | 120,000 | 180,000 |
| 1650 | 160 | 268 | 22 | 1 | Denture Clasp | 52,000 | 122,000 | 100,000 | 157,000 |
| 2500 | 95 | 95 | 23 | 23 | Paliney M | 24,000 | 24,000 | 60,000 | 60,000 |
| 1910 | 105 | 105 | 20 | 20 | Ney Oro T | 30,000 | 30,000 | 63,000 | 63,000 |
| 1660 | 95 | 165 | 22 | 6 | Ney Oro B-20 | 23,000 | 58,000 | 51,000 | 82,000 |
| 1850 | 45 | 45 | 25 | 25 | Ney Oro A | 7,800 | 7,800 | 31,000 | 31,000 |

**SPECIALISTS IN PRECIOUS METAL METALLURGY** NEY GOLD **SINCE 1812**

# From the Industry



## Air Reduction Company

Two new additions to its line of oxy-acetylene flame-cutting tips have been introduced by Air Reduction Company. The first, known as style No. 108, is intended for working in close quarters, being bent in an offset shape to permit cutting along a line $^{21}/_{32}$ in. from the vertical centerline of the torch head or barrel. This offset design facilitates the work of cutting close to bulkheads, flanges or shoulders where the torch head would ordinarily prevent alignment of the cutting orifice vertically over the desired line of cut.

The other new item is the style No. 139 straight tip, with one preheat orifice, for certain machine or hand-cutting operations. This tip is designed for splitting angle iron, straight-line cutting or sheet metal cutting operations, in which light preheat is desired.

## Aircraft War Production Council, Inc.

Through the recently formed Aircraft War Production Council, Inc., eight major aircraft builders in southern California are interchanging facilities, materials and normally secret processes in a new and greater degree of all-out production. Essence of the Council operation is speedy use of all regionally available facilities—at the point where they are most needed and at the moment they are most needed. The coordinating method seeks to get the most out of machines, materials, man power and minutes.

For example, hydropress machines at one member company have been turning out templates for another. A third company loaned to a fourth a group of sorely needed engineers. Engineers and research men jointly are attacking a hydraulics problem.

The Council has elected as President, J. H. Kindelberger, President of North American Aviation, Inc., and as Vice-President, Richard W. Millar, President of Vultee Aircraft, Inc. Their companies, with Consolidated Aircraft Corporation, Douglas Aircraft Company, Inc., Lockheed Aircraft Corporation, Ryan Aeronautical Company, Northrop Aircraft, Inc., and Vega Aircraft Corporation, form the council.

*Releases are printed as received from companies and other aeronautical organizations and the responsibility for the accuracy of all statements is therefore not assumed by the Aeronautical Engineering Review.*

Harry Woodhead, President of Consolidated; Donald W. Douglas, President of Douglas; Robert E. Gross, President of Lockheed; La Motte T. Cohu, Chairman of the Board of Northrop; T. Claude Ryan, President of Ryan; and Courtlandt S. Gross, President of Vega, together with J. H. Kindelberger and R. W. Millar, comprise the Council's Board of Governors.

## Boeing Airplane Company

The new multiengined Boeing AT-15 Crew Trainer was recently delivered to the Army Air Forces for test. It is said to be the first training airplane specifically designed and equipped for the integrated training of pilots, copilots, bombardiers, navigators and gun crews.

The purpose of the AT-15 is to give flight crews necessary training in coordination and teamwork before taking over tactical duties in multiengined bombardment airplanes. To provide the desired facilities the crew trainer is equipped with constant-speed propellers, radio compass, automatic pilot, full complement of flight and radio equipment, flexible machine gun, flexible camera gun, power turret and moderate-capacity bomb bays.

Representing the last step in the student advanced-training period, provision has been made in the airplane for crew members to receive individual instruction as well as group training. Conservation of aluminum alloys and castings and all critical materials needed in the production of combat airplanes was a prime consideration in the design of the AT-15.

Looking very much like a small twin-engined bomber, this crew trainer is constructed of steel tubing with wood-faired fabric-covered fuselage and plywood-covered wings and tail surfaces. Having a wing span of approximately 59 ft. and a length of 42 ft., this compact airplane attains a speed in excess of 200 miles an hour with its two Pratt & Whitney engines equipped with Hamilton Standard propellers.

## Boots Aircraft Nut Corporation

Designed to speed production of plywood airplanes and subassemblies, the Boots Self-Locking "Cage" Nut provides permanent fastenings for both plywoods and plastics. Incorporating the familiar wing style all-metal self-locking principle, this device may be applied from one side by one operator in a "blind" application if necessary.

This nut has a basket mount that is collapsed by the application of the clinching tool. The basket mount then clinches the plywood in a spider-like grip so firmly that it easily withstands, without tearing, the torque applied when a bolt is inserted by production methods.

The clinching tool that sets the mount into the plywood is adjustable to varying thickness by the use of stop arrangements. Thus, this single nut may be used with plywood or plastics from $^1/_8$ to $^1/_2$ in. thick.

## Buick Motor Division

An intensive training program for ground troops of the Army Air Forces, designed to produce a supply of fully trained aircraft-engine overhaul mechanics for the fighting fronts, is announced by the Buick division of General Motors Corporation. The training course will be devoted to field and depot servicing of engines built by Buick, providing expert mechanics in the numbers needed to overhaul, service and repair the engines in action.

The school will be conducted in a Buick service plant, which has been converted for the purpose, and will be exclusively for enlisted personnel of the Air Forces who have been selected by the Air Service Command, as a result of aptitude tests and individual preference, as candidates for aviation mechanics training. Under present plans the school will have an average daily attendance of several hundred students and

# THREE OFFERS AND A PROPOSAL

IMAGINEERING

★ SO MUCH SO SOON ★

***FIRST OFFER:*** If you operate *any kind* of equipment made of aluminum and you are baffled in any way in maintaining it in top condition—give us the facts, and we will rush you our recommendations.

We are busy making more millions of pounds a month than we made in a whole year, not so long ago—but not too busy to make sure that no single pound of aluminum at work anywhere on war effort shall fail to do its share of making whatever it takes to win.

***SECOND OFFER:*** If you are making anything whatsoever out of aluminum, and are stumped in any way in setting up the best methods of fabricating it—give us the facts, and we will see that you get all the know-how in our power.

***THIRD OFFER:*** If you have joined the host of those who believe that industry must even now be planning the new products that will make jobs when this thing is finally over; if you are letting your imagination soar: Won't you ask us to help you engineer it down to earth with all the up-to-date facts about Alcoa Aluminum, plus some of the very practical dreams we have been dreaming?

***AND THE PROPOSAL:*** Do some personal Imagineering, right now, for the sake of your own personal tomorrow.

We have been talking Imagineering for some months largely in terms of the future. And in terms of industry. But here is the personal slant:

Thirty billion dollars is loose in the country. It is the gap between what is available for spending and what is available for personal purchases. Each of us has a sliver of that chunk of excess purchasing power.

If we put it into War Bonds, we are told that it will both finance the war, and avoid inflation. We sometimes forget that it will also finance ourselves, as users of goods, to buy the new products we are all readying, as makers of goods. Buying tomorrow, today, is patriotism and sense—business sense.

Aluminum Company of America, 2142 Gulf Bldg., Pittsburgh, Pa.

# ALCOA ALUMINUM

ALCOA ALUMINUM

capacity is provided for doubling the currently scheduled number. The troops will be under command of Air Force officers.

The training course will concentrate in a compact program thorough instruction on the specifications and mechanics of the big aircraft engines, with maximum emphasis placed on the tear-down and rebuilding of the engines and "trouble-shooting." Its objective is to teach the men to be expert engine overhaul mechanics in the Army Air Forces' third and fourth eschelons.

## Consolidated Aircraft Corporation

Consolidated Aircraft Corporation has announced that the mass training of Army Air Forces mechanics has been undertaken. Working in conjunction with the Air Forces, Consolidated is training an initial group of 125 men. In a course covering four weeks, 550 men will be trained each month. The course has been designated the "B-24D Familiarization Course," and 26 Consolidated experts have been transferred to the educational department to teach the Army personnel.

The men will be trained only on B-24's and, upon completion of instruction, will be assigned to squadrons made up of these bombers.

To house the new school, a permanent community camp has been erected with eleven barracks, officer's quarters, two laboratory buildings, mess halls, a classroom building and an administration building. The training schedule is rotating, enabling 125 mechanics to graduate weekly. An intensive daily schedule includes two hours of lectures and one and one-half hours of airplane demonstration, with laboratory work filling out the day.

## Dayton Rogers Manufacturing Company

The Dayton Rogers Manufacturing Company, Minneapolis, Minn., has announced a new direction indicator for its precision adjustable spacing collars for milling machine cutter arbors. These adjustable spacing collars, being graduated in thousandths, facilitate the accurate spacing of all straddle, gang, and other multiple milling machine operations where two or more cutters are used.

The engraved direction indicator on the outer sleeve of the spacing collar definitely tells the operator which way to rotate the sleeve to obtain the desired adjustment. These adjustable spacing collars not only eliminate the use of milling machine cutter arbor shims but make it possible for the operator to get the desired adjustment more quickly and accurately because quarter-thousandth graduations are easily obtained. The collars are made of a special alloy steel, accurately engraved, with precision-machine quality throughout. They are made in eleven sizes for all cutter arbors from $^5/_8$ to 3 in.

## Despatch Oven Company

To enlarge heat-treating facilities for aluminum and magnesium alloy castings with furnaces having a ready and scientific control of heat-treating cycles, the Despatch Oven Company has developed a new gas-fired furnace.

The effective heat-treating chamber has a capacity of 10,000 lbs. of aluminum castings per charge with a maximum operating range of 1,250°F. Heated air from the outside "firebox" or heater is distributed through dozens of ducts within the furnace walls and floor and discharged at the velocity of a high gale into the working chamber at appropriate intervals directly against the load. An adjustable slide damper for each discharge port is provided for greater control accuracy. Recirculating ducts are built into the furnace on the opposite wall from the discharge duct to take the usable heat back to the firebox for reheating and recirculation.

Since no combustion gases enter the furnace proper, all types of aluminum alloys and magnesium alloy castings can be heat-treated. Normally, atmospheric air is the circulating medium, although a special protective atmosphere can be employed. Hot air is quite suitable for such important alloys as No. 43 (5 per cent Si); No. 195 (4 per cent Cu), for high strength parts of aircraft structure; No. 355 (1.3 per cent Cu, 5.0 per cent Si, 0.5 per cent Mg), aircraft-engine crankcases; and No. 356 (7.0 per cent Si, 0.3 per cent Mg), structural fittings.

Tests are said to have proved that a temperature differential of ±5°F. is consistently attained and that castings ranging in weight from 1 oz. to 4,500 lbs. can be heat-treated simultaneously with equally satisfactory results. An average fuel consumption for a period of two months of scheduled operation approximates 9,000 cu.ft. of natural gas for each net ton of charge.

## General Electric Company

An all-position, a.c. electrode, Type W-26, extending the advantages and convenience of high-quality a.c. welding to both vertical and overhead positions, has been announced by the General Electric Company.

Type W-26 electrode complies with the requirements of the following specifications: A.W.S. Filler Metal Specification E6011; Navy Bureau of Ships Specification 46E3, Grade 3, Class 1; and the A.S.M.E. Boiler Code, Paragraph U68.

By the use of this electrode, welding shops and fabricators who have heretofore needed to supplement their a.c. welders with stand-by d.c. welders for high-quality work in the vertical and overhead positions will now be able to release these machines for fabrication work where d.c. welding may be essential.

Type W-26 electrode is now available in $^1/_8$ and $^5/_{32}$-in. diameters; other sizes from $^1/_{16}$ to $^1/_4$ in. are expected to be available shortly.

Welds made with the $^5/_{32}$-in. diameter electrode show the following average physical properties, the data being obtained from all-weld metal test specimens in the "as-welded" condition: ultimate tensile strength, 72,000 lbs. per sq.in.; yield point, 60,000 lbs. per sq.in.; elongation in 2 in., 26 per cent; reduction of area, 46 per cent.

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A new four-pole relay, designated CR2791-G100K, has been added to the line of General Electric control devices for aircraft applications. Features of the new relay are its light weight, permanence of contact position under severe vibration conditions, and operation at high altitudes at rated current.

The relay has a maximum continuous current rating of 10 amp. at 12 or 24 volts d.c., and a maximum make-or-break current rating of 50 amp. at 12 or 24 volts d.c. The normally open contacts have a tip travel of $^3/_{64}$ in. Coil wattage is 1.80. The relay weighs 0.281 lbs. Dimensions are: length, $2^1/_2$ in.; width, $1^5/_{32}$ in.; and height, $1^{25}/_{32}$ in.

## Kollsman Instrument Division

In response to numerous requests from flying schools for templates or dummy instruments for making up instructional panels, the Kollsman Instrument Division of Square D Company has made available an instrument panel with dials equipped with movable pointers. The panel is rigid and equipped with an easel to facilitate its use in the classroom. The panels are available to flying schools and other institutions giving instruction in aeronautics at the nominal cost of $1.00 each, including shipping.

An Altitude Temperature Relationship Indicator has also been developed to show the pilot graphically the effect of temperature on the air column and altimeter reading. It gives the amount of difference between the "true" and "indicated" altitude at various altitudes and temperatures.

## Leslie Welding Company

A new die set for press brakes has recently been introduced for which numerous advantages are claimed over conventional sets. This die set was de-

veloped from a new aligning principle to provide a means of producing extremely large stampings through the use of a press brake. It is intended to increase greatly the range of work that can be done on press brakes, making practical and economical their use for numerous stamping and blanking operations on large-sized sheets or plates that heretofore could be done only with large straight side presses. This new type of die set permits work on almost unlimited length and width (throat depth) and also gives accurate die alignment without leader pin die sets. Screws and dowels for attaching punch plates and dies to the punch holders and die shoes are readily accessible while the die set is in the press brake, so individual punch and die assemblies may be removed for repairs or change without disturbing the remainder of the setup. An example of the work done is a 20-ft. section of an airplane wing which would ordinarily be done in a straight side press. These die sets can be produced as needed in almost any toolroom from ordinary steel plates and shapes, thus saving the time that would otherwise be lost while die sets are ordered, manufactured and delivered from outside suppliers. Other advantages claimed are the self-balancing feature and simplification of the process of die making, die setting, maintenance and repair. Specially skilled operators and constant attention are not required.

## Lockheed Aircraft Corporation

Solving a problem of many years, the perfection of new welding goggles that will help speed up production by entirely eliminating glare from aluminum welding operations was announced at the Lockheed Aircraft Corporation. These goggles will be made available to all airplane manufacturers.

Aluminum welders had been severely handicapped by the glare from the hydrogen torches, which caused severe eyestrain and hid their work from direct view, making welding a difficult operation. This glare is caused by the low temperature at which aluminum melts, the high temperature of the hydrogen torch and the large amount of flux required in this type of welding.

The glare problem was solved by Dr. R. C. Burt, a member of the Lockheed Plant Engineering Department, who, with the help of Corning Glass Works technicians, produced a pair of goggles with optical properties that would filter out the glare. As now used, the improved lenses allow a small cone of flame to be seen at the burner tip.

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A new device, known as the "Holly Tube Bender," has been developed by a Vega engineer. It is a precision machine enabling the operator, by a system of gauges, to make any bend or rotation in small hollow tubing within one-half a degree of accuracy. Forming blocks of a quick clamping type, containing special forming grooves, prevent the tube from flattening while being bent.

The machine simplifies the bending of tubing of from $^1/_8$ to $^5/_{16}$-in. dimensions. It features a metal rod with a 360-deg. protracting dial and a protracting base, along with a 6-ft. flexitape rule.

It is stated that output has been raised from 400 bends per shift with many rejections under the old method to 1,800 bends in the same time with practically no rejections, and women can do the work instead of men.

Glare reduction with new type welding goggle developed at the Lockheed Aircraft Corporation with the help of Corning Glass Works technicians. The new type goggle eliminates the glare from both the welding torch and the molten aluminum.

## The Glenn L. Martin Company

Some details of The Glenn L. Martin Company's new design for a 250,000-lb. air vessel have been released. This design is ready for actual construction at any time, according to the builders, and could be used either for a military transport or a commercial seaplane. The new aircraft would be able to carry 102 passengers, each with 80 lbs. of luggage, as well as 25,000 lbs. of mail and cargo, to London in 13 hours. As a commercial vessel, for which the design was primarily intended, it would be able to rival the payload carrying capacity of a surface steamship in a year of operation. As a military transport, it would be able to carry 150 armed men and their equipment. The interior of the hull is equivalent in cubic capacity to that of a 15-room house.

## Mead Specialties Company

One of several different models of air clamp developed by the Mead Specialties Company is suitable for holding castings while being tapped. The clamp holds the work rigidly in position, but on completion of an operation the pressure is released by a foot control and the work is rotated to the next position in which it is tightly clamped for a repetition of the operation.

In other applications one or more air clamps are used to supplement each other, providing flexible and quickly removable means for holding work in place.

## Nash-Kelvinator Corporation

Details on the conversion to armament work which has been accomplished by the subsidiaries of Nash-Kelvinator Corporation. The company was first asked to build Hamilton Standard hydromatic variable-pitch propellers. A second and larger propeller contract was awarded to the company and meanwhile another subsidiary was given the task of converting its peacetime production of electrical controls to the making of parts for the automatic pilots used in bombers. A third assignment was the building of Pratt & Whitney engines, for which one of the company's former automobile plants is being converted. Finally, the company was called upon to build complete flying boats, similar to those built by Vought-Sikorsky for transoceanic commercial service. This undertaking is so large

that several plants in various parts of the United States will be required to fill the contract. The company is also manufacturing other kinds of war material.

## Oakite Products, Inc.

Because aluminum and magnesium are sensitive metals which, unless extreme care is exercised, become pitted, etched or discolored when cleaned with harsh alkaline solutions before and after heat-treatment, Oakite Products, Inc., has announced newly developed and improved methods for effectively handling these operations on a safe basis.

Removal of oil, dirt and fabricating greases from aluminum and magnesium parts before heat-treating can be accomplished by immersing parts for a required period in a suitable tank charged with solution of Oakite Aviation Cleaner at a strength of 4 oz. per gal. of water. Temperature of solution is maintained at a point from 170° to 212°F., depending upon conditions. Time of immersion is usually five min., but may vary somewhat according to amount of soil present. Cleaning is completed by giving the parts a thorough running water rinse.

Heat stains or discoloration appearing on aluminum sheets and parts as a result of heat-treating and quenching may be completely removed and original finish of parts restored by immersing the work from 2 to 15 min., subject to condition of parts, in a solution of a newly developed material, Oakite Compound No. 84-A, 8 oz. per gal. of water, temperature 180°F. In those cases where oil and grease are present, as well as the heat-treating film, work is precleaned by the tank method with Oakite Aviation Cleaner prior to immersion in solution of Oakite Compound No. 84-A.

The material and methods employed for removing heat stains or discoloration are also equally suitable with variations for use in connection with such other operations as (1) degreasing aluminum parts before anodizing; (2) preparing aluminum alloy structures, assemblies and parts for resistance spot welding; (3) removing anodizing film from rejected aluminum parts; and (4) stripping anodizing coatings from racks, straps, hooks, etc. Concentration and temperature of solution and time of immersion are determined by the particular types of work to be done and condition of the parts to be cleaned or stripped.

## Progressive Welder Company

A standardized flexible installation for the production spot welding in assembly of light-gauge aircraft steels, including stainless steels, has been developed by Progressive Welder Company. Incorporating a number of features—such as refrigerated electrodes, variable throat depth, and welding transformer built into a lightweight welding gun—the welding installation includes a jib crane with 6-ft. trolley-type arm.

Since the equipment is completely self-contained, with all units mounted on or suspended from the jib crane, it is easy to install and may be used over a wide area, particularly in working on large assemblies or in combination with moving conveyors. As an additional flexibility feature, the gun hanger is so designed that the gun may be swiveled 360 deg. in any plane, facilitating welding in normally hard-to-get-at places on an assembly.

The gun is light in weight and is spring counterbalanced. It may be adjusted for throat depth by changing the electrode arms. Relatively small diameter electrodes are normally used, the needed welding pressure being provided by an air cylinder on the gun. The factor that makes the use of small diameter electrodes possible is the application of refrigeration to the installation. Mounted on top of the jib crane is a refrigerating unit that circulates brine through the electrodes, maintaining the latter at below freezing temperatures. This is said to prevent the mushrooming and deformation that ordinarily are caused by the use of small-size electrodes under relatively high pressure. By reducing water consumption the refrigerating unit also decreases the cost of operation. The electrodes may be retracted a total of 2 in. at the touch of a control lever.

Incorporating the welding transformer directly in the gun is said to eliminate the need for secondary leads from the transformer, to increase accuracy of welding control and to reduce current losses. The transformer, as well as the electrodes, is refrigerant-cooled. It is rated at 8,000 (secondary) amp. at 6 volts and controlled by a three-step heat switch. Pushing the control button on the gun actuates an electronic timer mounted on the jib-crane column through an air valve located immediately above the swiveling hanger. Types of timers vary for specific needs but all include built-in contactors. Phase-shift heat control and synchronous timing are available at extra cost.

## Tinnerman Products, Inc.

"Twin-Type" speed nuts have been designed to reduce both weight and assembly time for attachment of fair-lead guide blocks. Requiring only a screw driver for assembly, they eliminate many handling operations, washers and the use of wrenches.

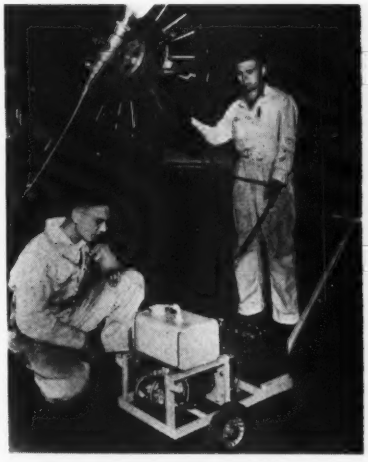
This Twin Speed nut is designed for use also on other attachments throughout the airplane where fastening points are grouped in pairs. Manufactured with or without center hole for riveting, they are made in the following sizes, which indicate distance from center to center of screw holes: 1/2, 5/8, 3/4, 7/8, 1 in., for either AN 515–6 and 515–8 or Air Corps 530–6 and 530–8 screws. In ordering these nuts it is necessary only to specify the screw size, spacing from center to center of holes, and whether they are desired with or without rivet hole in speed nut.

A new line of Tinnerman shop nuts which has also been introduced recently is said to save as much as 40 per cent in labor time. These use standard Parker-Kalon sheet metal screws, colored in the same manner and with threads two and one-half times coarser than machine screws which speeds up insertion.

With rounded corners and turned up ends, these shop nuts will not score aluminum surfaces. This eliminates the necessity of using fiber washers.

## United Air Lines

A new engine preoiling device, used to prevent bearing wear when an engine is started cold, has been developed by students at the Boeing School of Aeronautics, division of United Air Lines, at Oakland, Calif.



The preoiler device built by students of the Boeing School of Aeronautics and used to prevent bearing wear when an airplane engine is started cold.

The device, mounted on wheels for convenience in handling, consists of a 2-gal. tank, storage battery, electrically operated gear pump and pressure-relief valve.

The lubricant circulated by the preoiler may be the same grade as that contained in the engine, or a light grade may be used. If the same grade, the oil should be heated and then circulated through the engine under pressure.

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## —PHILLIPS—
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SPEED • STRENGTH

**Firmly established as the modern method of fastening, HOLTITE-Phillips Screws and Bolts have been important factors in stepping up war production to an all-time record. Greatly increasing hand driving, and making power driving possible on jobs previously requiring slower methods, these modern fastenings are the yardstick by which assembling time is measured.**

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# CONTINENTAL SCREW COMPANY
New Bedford Mass. U.S.A. *Warehouse*-Detroit Mich.


### United Aircraft Corporation

A test of the interchangeability of engines built in the Pratt & Whitney Aircraft plant at East Hartford, Conn., and others built by the automobile industry has been reported. Engineers took two Twin Wasp engines, of which one had been built in its own plant and the other in a plant of Buick Motor Company. Each engine had been completely assembled in the plant where it was built but neither had received the so-called "green test." The engines were torn down, thoroughly inspected, and then parts of the two were interchanged. Every conceivable combination of parts was switched from one engine to the other.

The two engines were then assembled, with no special hand fitting, and run through the normal "green test." They were torn down again and inspected. Examination of inspection sheets for the two engines showed both to be in normal condition at the completion of the test. They passed all tests so well that they were reassembled with the interchanged parts still interchanged and shipped for duty.

### Vega Aircraft Corporation

Production of Flying Fortresses under the Boeing-Vega-Douglas pooled facilities program has been advanced six months through the use of an electrolytic transfer process by which the master pattern, or work template, can be reproduced in five min.

There was in existence only one complete set of these templates for the B-17 Flying Fortress, at the Boeing Aircraft Company plant in Seattle. Duplicate sets were needed at both Vega and Douglas to enable those two companies to start work. The electrolytic transfer process, a Lockheed invention and patent, was utilized as a means of eliminating the tedious, time-consuming hand reproduction of these duplicate working patterns, effecting substantial savings of both time and money. This saved each company about 50,000 man-hours, or a total of some 150,000 work-hours that would have to be completed before manufacturing of parts, tooling or jig building could even have started.

There are only three steps in making work templates by the electrolytic process: (1) the preparation of the original drawing by an engineer; (2) the scribing of the drawing on a specially treated metal sheet to make the master layout; and (3) the transfer of the scribed layout (with all the detailed information noted on it) to an inexpensive metal copy sheet from which the work template is cut. The copying operation is routine and can be taught an unskilled employee in a comparatively short time. Furthermore, the electrolytic process

eliminates the danger of errors being made each time the master layout is copied and assures the exact reproduction of each work template, regardless of how many there may be.

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Another method by which production has been stepped up at least three months is the use of walnut shells and ordinary cooking utensils. Ground walnut shell flour is mixed with an oil resin, manufactured locally, and a catalyst or accelerator. This thermosetting composition is mixed thoroughly in the baker's bread mixer and then poured into molds. Special compounds for the making of these molds are previously mixed in an ordinary copper kettle.

The mix is allowed to set for a few minutes and is then placed in an oven at 175°F. and allowed to "bake" or "cure." The plastic is then sent to the shop, where it may be used as a drill jig, a forming die that will stand up to 8,000-lb. pressure per sq.in. under the hydropress, a formed router block, a shaper block, saw jig, punch jig, checking fixture or forming die for Plexiglas noses.

## Weltronic Corporation

A new full-electronic timer and control designed for use with seam welders, as well as spot welders, has been announced by Weltronic Corporation, Detroit, Mich. When used with spot-welding machines, the new Model 40 timer provides both single-spot and pulsation-type welding controls. Of the synchronous type and incorporating phase-shift-type heat control, the Weltronic 40 starts and stops current flow at the zero point of the current wave, while current duration is adjustable to the exact number of cycles desired. The cabinet housing the control is of the standard Weltronic four-panel type, providing the necessary switches, dials and other instruments for varying the time and frequency of operation.

Provided in the timer is a built-in tube contactor. The capacity of this contactor is the only variable necessary in the entire control to adapt it to varying capacities of welding operations. A wide selection of electronic contactors is available to suit specific requirements. When used for "single shot" type of spot welding, the toggle switch is thrown to the "on" position and the dial controlling the number of pulsations is set to "1." With this setting, the control is a straight synchronous spot-weld timer with phase-shift heat control, particularly suitable for the welding of light-gauge alloy steels.

To use the timer for pulsation welding, the same setting is used as for single-shot spot welding, except that the "pulsations" dial is set to the number of pulsations desired.

The new lamping bridge used by the Vega Aircraft Corporation for servicing and replacing the over 18,000 fluorescent lamps hung 35 to 40 ft. above the floor. A monorail crane is used in towing the bridge.

When used for seam welding, "heat" and "cool" controls are set to the values desired and the toggle switch is thrown to the "off" position, which cuts out the pulsation limiting control. Heat and cool cycles will then repeat automatically until the seam weld has been completed and welding is interrupted by the welding machine start-and-stop control.

## Wright Aeronautical Corporation

The operation of single-cylinder aircraft-engine test stands in the plants of Wright Aeronautical Corporation, in Paterson, N.J., is helping to speed new and more powerful engines into production and at the same time is steadily improving parts and, consequently, the performance of power plants now being turned out for United States airplanes.

These stands duplicate a regular, full-sized Cyclone 9 in every respect, except that eight of the engine's nine cylinders have been removed and the drive shaft, instead of spinning a propeller, exerts its force against a brake mechanism for registering horsepower. With these single cylinders, engineers run tests on pistons, spark plugs, valves, piston rings, piston pins, intake and exhaust ports, and cooling fins. Tests of hundreds of variations and combinations of these items are run in a short time, saving not only the expense of operating a complete engine, but valuable days of test time and releasing the regular test cells of the company for production use on full-sized engines. In addition, a test on a specific part can be run to the point of failure on the single-cylinder stands.

Design features in the cylinder and its component parts can be tested, modified, rejected, improved or approved without change before a full-scale model of the engine is constructed for extensive ground and flight tests, while troubles that crop up in service engines may be relentlessly pursued.

With engine speeds, cylinder compression ratios and horsepower output per cylinder increasing sharply in recent years, new and improved types of spark plugs were a necessary development and the single-cylinder stands were consequently put to use testing new plugs as they were produced. In fact, a considerable part of the total test time has been on spark plugs.

As power per cylinder increases, the problem of cooling also increases. Research engineers find the single-cylinder engine a fast and effective means of testing different arrangements of cooling fins. The present connecting points for taking temperature readings on the cylinder base and head, important for fuel economy and engine safety, were determined by running tests on all parts of a cylinder to determine the hottest areas.

One-cylinder test stands have been used on a limited scale for some years, since their advantages quickly became apparent when the radial air-cooled engine moved into the production stages. Their application on such a large scale, however, is now the trend in the aircraft-engine industry.

# Institute News

## New Corporate Member

The Bell Aircraft Corporation, Buffalo, N.Y., is the latest addition to the list of Corporate Member companies that participate in the support of the Institute's activities and publications. The company was founded in 1935 by Lawrence D. Bell, M.I.Ae.S., its President. From the beginning the organization concentrated on the design and manufacture of military aircraft and now produces the Airacobra, which has seen service on all the major fronts of the present war. A motion-picture film, recently produced by the Bell company entitled *Cannons on Wings* is now available for loan to Institute Sections and Branches and other groups. It describes the design, construction and performance of this pursuit interceptor plane.

## Membership Emblem

The Membership Emblem shown above, to be worn in the coat lapel, is available to members of the Institute.

A change has been made in certain of the color combinations to indicate various grades of membership. The black enamel on gold design will be used to designate Honorary Fellows, Fellows and Associate Fellows. Black on silver will identify MEMBERS, Industrial Members and Technical Members. White enamel on gold will be for Affiliates and white on silver for Student Members. The price of each emblem is $1.00 except for the design for Student Members which is 50 cents. Student Members should order emblems only through the officers of their Student Branches. Members in other grades and Affiliates who wish to have emblems should order them directly from the Institute. A special order form is provided and will be sent on request.

# Sections and Branches

## Detroit Section

The Section's last meeting of the season was held on Wednesday, June 3, at the Rackham Educational Memorial in Detroit. The speaker of the evening was Charles S. J. MacNeil, Chief Engineer, Aeroproducts Division, General Motors Corp., who presented an illustrated lecture on "Development of Modern Controllable Propellers." A motion picture describing the installation and maintenance of hydromatic aircraft propellers produced by Hamilton Standard Propellers Division of United Aircraft Corporation was also shown at the meeting. James W. Kinnucan, Chief Engineer, Detroit Division, Continental Motors Corporation, acted as Chairman of the meeting and led the discussion that followed the lecture and motion picture.

## San Diego Section

On June 12 the San Diego Section held "A Symposium on Motorless Flight" at the San Diego Hotel. Hawley Bowlus, founder and Vice-President of Bowlus Sailplanes, Inc., who has long been associated with glider activities in this country, spoke on the status and future of motorless flight. He showed a color motion-picture film produced by his company which depicted gliding activities throughout the United States. Through the courtesy of the West Coast Air Forces Training Center, Capt. Floyd Sweet, Commanding Officer of the Twenty Nine Palms Air Academy, addressed the meeting and described the training courses being given in soaring flight. He presented a film that showed the history and methods of the Academy, group formations of gliders, glider line flying, etc.

The San Diego Section has held several meetings this year. Its officers are: Chairman—Ernest G. Stout, Chief Aerodynamicist, Consolidated Aircraft Corp.; Vice-Chairman—F. P. Faulconer, Director of Education, Consolidated Aircraft Corp.; Corresponding Secretary—P. W. Faulconer, Engineering Dept., Consolidated Aircraft Corp.; Treasurer—Jack Mason, Engineering Dept., Consolidated Aircraft Corp.; Chairman of Papers Committee—Stanley H. Evans, Ryan School of Aeronautics; Chairman of Meetings Committee—Joel M. Whitney, Ryan School of Aeronautics.

## Academy of Aeronautics

The initial meeting, at which steps were taken to organize a Student Branch at the Academy of Aeronautics, La Guardia Field, New York City, was held last December 17, the thirty-eighth anniversary of the first flight of the Wright Brothers. The meeting was attended by senior students in aircraft design, which is the principal course given at Academy, as the facilities for the mechanics courses have been suspended and turned over to the Army Air Corps since this country's entrance into the war. The Academy of Aeronautics is affiliated with the Casey Jones School of Aeronautics in Newark, N.J., which has had an active Student Branch of the Institute for some years. Walter M. Hartung, Chief Instructor for both schools, acts as Honorary Chairman for both these Student Branches. Milton M. Edwards, Instructor of Aeronautical Engineering at the Academy of Aeronautics, is Faculty Advisor of the new Branch. An active program of meetings has been held since the preliminary meeting and members of other classes have been invited to attend the presentations of technical films and technical papers, many of which have been written by the members. Early last month organization of the Branch was completed, members were enrolled in the Institute, and the following officers of the Branch were installed: Chairman—Theodore Hoffacker, Jr.; Vice-Chairman—James D. Johnson; Recording Secretary—Anthony L. Belbruno; Treasurer—David M. Wilde; Corresponding Secretary—Serge Gagarin; Sergeant-at-Arms—Justin L. Baker.

## The Aeronautical University

The Executive Committee of this Branch has planned a series of feature meetings, the first of which was held on May 12. The speaker was Gunther

Schwandt, member of the faculty of The Aeronautical University, who presented a lecture on "Unconventional Aircraft." He spoke on the design introduced by the Frenchman, Henri Mignet, and discussed not only the construction and unusual features but also the history and reason for its origin. In addition to blackboard sketches of the original Mignet airplane and its aerodynamic principles, blueprints were posted of the more recent HM-25 which was developed at the American Mignet Corporation at Palwaukee Airport, where Mr. Schwandt had been employed as engineer and had taken part in flight testing and experimental work. A lively question-and-answer period followed the lecture, during which Honorary Chairman Reed gave a description of an earlier Mignet plane.

On May 25 the motion-picture film produced by Vultee Aircraft describing the Messerschmitt Me 110 was shown. On June 2 a business meeting was held at which plans for an outdoor social function were discussed and it was announced that the Executive Committee had authorized a first prize of $10 and a second prize of $5.00 to be awarded to members presenting the best technical papers at Branch meetings. Reports of meetings and activities are written up at length and posted on a special bulletin board at the school which serves as an informal publication for the Branch.

### Boeing School of Aeronautics

At the Branch meeting held on June 1, the motion-picture film issued by the Consolidated Aircraft Corporation entitled *PBY Record Breakers* was shown. The entire student body of Boeing School attended.

### Carnegie Institute of Technology

Since the class of '43 at Carnegie Tech will carry on studies throughout the summer in order to graduate in December, 1942, the Student Members reorganized the Branch in May instead of waiting until October. New officers elected were as follows: Chairman—Charles Le Bon; Vice-Chairman—Willis Bowman; Secretary-Treasurer—Robert L. Sayre. Professor Allen H. Blaisdell continues as Honorary Chairman. Membership dues of $1.00 for the June to December term were authorized.

### University of Detroit

At the meeting on June 4 Ian Gray spoke on the possibility of more papers being presented by Student Members at branch meetings since there are a number of members who already have had experience in various phases of aeronautical production such as tool and die designing, etc. He spoke about the Student Awards given each year by the Institute for the best papers presented at Branch meetings by senior students and suggested that the Detroit Branch could arrange to give its own awards for the best papers given by juniors and prejunior students. Mr. Tweney spoke on the history of the Branch, which was the first to be organized by the Institute. The meeting concluded with a showing of the slide film on *The Engineer's Relation to Production*. Leonard DeCoster read the commentary accompanying the picture.

### Indiana Technical College

On May 10 the Branch held a farewell banquet in honor of Prof. James J. Ross, Honorary Chairman, who is leaving Indiana Technical College to accept a position with the C.A.A. At the meeting on June 10, Prof. James Hailstones, newly appointed Honorary Chairman, was introduced to the Branch members and Ray Gilbert Trout and Clarence L. Forrest were elected to the Student Council as representatives of the Aeronautical Department of the college. Several new members of the Branch were enrolled at this meeting.

### University of Kansas

At the meeting on April 16 Chairman James Bond introduced Mr. Kenneth Razak, Instructor in the Department of Aeronautical Engineering, recently appointed Honorary Chairman succeeding Prof. E. E. Brush, who has left the University of Kansas. Jules Saut, Vice-Chairman, gave a talk on the production and uses of magnesium in aircraft and reported on a recent inspection trip through plants of the Dow Chemical Company. James Bond gave a report illustrated by lantern slides and the motion-picture film *Look to Lockheed for Leadership* was shown.

### University of Notre Dame

New officers elected at a recent meeting are: Faculty Sponsor—Prof. Frank N. M. Brown; Chairman—William F. Ungashick; Vice-Chairman—Arthur Ley; Secretary-Treasurer—William Waeldner. Their terms will extend to December, 1942, since the present academic year is continuing through the summer until that date. At a meeting on June 11 plans for the activities of the Branch including an interclass athletic program were discussed. Mr. Edward Kavenaugh, newly appointed Instructor in the Department of Aeronautical Engineering, and Prof. Robert Eikenberry, Professor of Aeronautical Engineering, were introduced to the Branch members. The Hamilton Standard Propeller film *Keep 'Em Flying* and a motion picture produced by the U.S. Army Signal Corps on Diesel engines were shown. Discussion of the films was led by Mr. Eikenberry.

### The University of Oklahoma

The organization meeting of this new Student Branch was held on May 7. Paul Browne acted as Chairman. The N.A.C.A. motion-picture film *The Fundamentals of Air Flow and Air Flow Separation* was shown with introductory remarks by Don Malvern. After the film Mr. Browne and Professor L. A. Comp explained the aims, purposes and activities of Student Branches of the Institute. A motion to form a Student Branch of the University of Oklahoma was duly passed and the following officers were elected: Chairman—Don Malvern; Vice-Chairman—Paul Browne; Secretary-Treasurer—Tom Higgins, Jr.; St. Pat's Representative—Claude Culp. Branch dues of fifty cents per semester were authorized. Professor Comp acts as Honorary Chairman of the Branch.

### Purdue University

A reorganization meeting of the Student Branch at Purdue was held on April 30. The Constitution and By-Laws for Student Branches were read and the following were elected officers of the Branch: Chairman—Karl Schakel; Vice-Chairman—Fred Vollmer; Secretary-Treasurer—Robert J. Wingert; Honorary Chairman—Professor E. F. Bruhn. The motion picture on the stalling characteristics of the Lockheed 14 was shown. At a meeting on June 3 applications from new members were received and Fred Vollmer and Robert J. Wingert were appointed Chairmen, respectively, of the Publicity and Membership committees. The motion picture produced by Bell Aircraft Corporation, *Cannons on Wings*, was shown.

## News of I.Ae.S. Members

**George P. Baker,** M.I.Ae.S., Vice-Chairman of the Civil Aeronautics Board, has received a temporary assignment to the Office of the Quartermaster General, War Department.

A commission as Major in the Army

Air Forces has been conferred upon **Allan A. Barrie,** M.I.Ae.S., pilot for Western Air Express, Inc., who has left the air line for military duty.

**William S. Beller,** former Stress Analyst for Brewster Aeronautical Corp., has joined Hughes Aircraft Co. as an aerodynamicist.

**Steven E. Belsley** has been appointed by the N.A.C.A. as an Assistant Aeronautical Engineer on the staff of the Ames Aeronautical Laboratory. He was recently an aerodynamicist with North American Aviation, Inc.

**Lt. John D. Bowen,** who had been an Assistant Aeronautical Engineer at the Langley Memorial Aeronautical Laboratory of the N.A.C.A., has been assigned to duty with the Experimental Engineering Section at Wright Field.

Curtiss-Wright Corp. announces that the Flight Test Unit, Propeller Test Unit, Vibration Test Unit and Experimental Laboratory—all in the Propeller Division—have been consolidated into one department to be known as the Experimental Section, which is to be headed by **George W. Brady,** F.I.Ae.S., Chief Engineer of the Propeller Division.

Because of pressure of duties as President of Bendix Aviation Corp., to which he was recently elected, **Ernest R. Breech,** M.I.Ae.S., has resigned from the chairmanship of the Board of Directors of North American Aviation, Inc. He is succeeded in this office, which he held since May, 1933, by Henry M. Hogan, Vice-President of General Motors Corp., who has been a Director of North American since 1934.

**Frank B. Chapman** has joined the faculty of The Agricultural & Mechanical College of Texas as an Instructor in the Engineering Dept. He had been on the engineering staff of Lockheed Aircraft Corp.

New Assistant Chief Engineer of Laister-Kaufmann Aircraft Corp., is **R. N. Chapman,** formerly Head of the Dept. of Aeronautical Engineering, Lawrence Institute of Technology.

**Richard I. Congdon** has left United Air Lines, where he was a meteorologist, to accept a similar position with the Alaska Division of Pan American Airways System.

The two colleges of which he is an alumnus awarded honorary degrees to **William K. Ebel,** F.I.Ae.S., at recent commencement exercises. Heidelberg College of Tiffin, O., from which he graduated in 1921, conferred the degree of Doctor of Science, and Case School of Applied Science, at Cleveland, honored him with a Doctorate of Engineering. Immediately upon his graduation from Case School in 1923 as a Bachelor of Science in Mechanical Engineering, Mr. Ebel joined the staff of The Glenn L. Martin Company, then located in Cleveland, as a Draftsman, later to become a Stress Analyst and Designer. After a year with The Douglas Company in 1925–1926, he returned to Martin's as Assistant Chief Engineer, then Chief Engineer and Test Pilot. He is now Vice-President in charge of Engineering and a Director of The Glenn L. Martin Company but still keeps a hand in test flying, his latest test flights being in the new Martin "Mars," the world's largest flying boat.

**Lt. D. W. Farnham,** U.S.N.R., has left his position as Field Engineer for International Petroleum Co. Ltd. to go on active naval duty.

**Walter W. A. Fischer** has been transferred from previous work as a meteorologist with United Air Lines to that of Development Engineer.

**Major J. P. Fraim, Jr.,** Army Air Forces executive officer, is serving with the Ferrying Command. He was Director of the Dept. of Aeronautics and the Flight School of Louisiana State University, where he had taught aeronautical engineering since 1932.

**Donald P. Frankel** has been changed from Test Engineer to Engineering Representative for Allison Division, General Motors Corp.

**Carl A. Frische,** M.I.Ae.S., of the engineering staff of Sperry Gyroscope Co., is now Director of Flight Research for that company.

**R. E. Gillmor,** A.F.I.Ae.S., President of Sperry Gyroscope Co., and R. Randall Irwin, Director of Industrial Relations for Lockheed Aircraft Corp., are aviation industry members of the Management-Labor Policy Committee appointed by the War Manpower Commission to consider and make recommendations on matters of major policy to the Chairman of the Commission, Paul V. McNutt.

**William R. Graf,** formerly a Draftsman with the Airplane Division, Curtiss-Wright Corp., is now in the Army serving as a 2nd Lieutenant of Infantry.

Lockheed Overseas Corp., which was incorporated in February as a subsidiary of Lockheed Aircraft Corp., is headed by **Robert E. Gross,** M.I.Ae.S., President and Chairman of the Board of the parent company. It includes on its Board of Directors **Hall L. Hibbard,** F.I.Ae.S., Vice-President and Chief Engineer, and C. A. Barker, Cyril Chappellet, Courtlandt S. Gross, Carl B. Squier and R. A. Von Hake.

Recently appointed Assistant Chief Engineer of Fairchild Aircraft Division, Fairchild Engine & Airplane Corp., is **Joel M. Jacobson,** A.F.I.Ae.S., formerly Assistant Chief Structural Engineer of The Glenn L. Martin Co.

**C. S. Jones,** M.I.Ae.S., President, Casey Jones School of Aeronautics, has been made a Director of National Aviation Corp.

**J. P. Killian,** M.I.Ae.S., recently Schedules Engineer with Republic Aviation Corp., has joined the engineering staff of the Eastern Aircraft Division, General Motors Corp.

**Randall W. Kirk** has been promoted from Apprentice Engineer, Pacific Division, Pan American Airways System to Junior Engineer with Pan American Air Ferries.

**Herbert F. Kueck** has returned to the Engineering Dept. of Beech Aircraft Corp. He was an Instructor at the Daniel Guggenheim School of Aeronautics, New York University, last year, where he completed the requirements for a Master's degree in Aeronautical Engineering.

**Lt. David S. Little,** U.S.N.R., M.I.Ae.S., has been appointed Head of the Radio Subsection, Radio-Electrical Section, Bureau of Aeronautics, Navy Department. He was recently a Pilot and Radio Engineer with American Airlines and for some years previous to that had been in charge of Aviation Radio Sales for RCA Mfg. Corp.

**Oscar Loeser,** A.F.I.Ae.S., has been transferred from Lakehurst Naval Air Station, where he had been civilian Chief Engineer and a member of its Engineering Division since 1935, to another Naval Air Station on the East Coast, where he is now commissioned as a Lieutenant Commander, serving as A. & R. Officer.

**Dr. A. E. Lombard,** A.F.I.Ae.S., who left the faculty of California Institute of Technology to become Chief of Aircraft Production Planning for the War Production Board when that agency was first set up as O.P.M., has been appointed Administrator of the W.P.B. Aircraft Scheduling Unit, located at Dayton, which represents W.P.B., the War Department and the Navy Department in joint control over detailed scheduling of materials, equipment and machine tools for the aircraft industry. Dr. Lombard continues as Chairman of the Subcommittee on Allocation of Deliveries of the Joint Aircraft Committee.

**Hoshen Lu,** who had been a Research Fellow in the Aeronautical Department, University of Minnesota, is a Structural Engineer with the Airplane Division, Curtiss-Wright Corp.

**John M. Luther,** M.I.Ae.S., Assistant Chief Engineer of Globe Aircraft Corp., has been assigned to the company's Wichita Liaison Office with duties as Chief Liaison Officer.

**Andrew A. Mahoff** has resigned

from the faculty of Georgia School of Technology to become an Aeronautical Engineer with the Douglas Aircraft Co.

**Glenn L. Martin,** Hon.F.I.Ae.S., President of The Glenn L. Martin Co., received the American Design Award conferred annually by Lord & Taylor, New York department store. At the award dinner held on May 22 Mr. Martin spoke on "The Fundamentals of Future Aircraft Design."

**John R. McVeigh,** M.I.Ae.S., who was formerly Chief Designer in charge of Drafting for Mawen Motor Corp., has joined the staff of the Aircraft Engine Division, Packard Motor Car Co.

**Major R. L. Meredith,** A.F.I.Ae.S., formerly Test Pilot and Engineer for Aircraft Radio Corp., has been on duty with the Army since February.

**W. P. Montgomery,** M.I.Ae.S., has been appointed Assistant Chief Engineer of Duramold Aircraft Corp., a division of Fairchild Engine & Airplane Corp. He had been in charge of Structural Research for Vought-Sikorsky Aircraft Division, United Aircraft Corp.

Aeronautical courses at Iowa State College have been reorganized as a separate Department of Aeronautical Engineering headed by **Prof. Wilbur C. Nelson,** A.F.I.Ae.S., who had previously been Assistant Professor of Aeronautical Engineering in the Department of Mechanical Engineering. He will be assisted by John M. Coan, formerly of The Glenn L. Martin Co., who will be Assistant Professor in charge of Aircraft Structures, and Lester G. Kelso, of Boeing School of Aeronautics, who will be Instructor in Aeronautical Engineering.

The Aeronautical Chamber of Commerce of America has announced the appointment of **Eugene W. Norris,** M.I.Ae.S., to its Technical Dept. for full-time work with the National Aircraft Standards Committee. Mr. Norris was Chief of the Specifications Section, Aircraft Engineering Division, C.A.A.

**John F. Roth** has resigned from the Engineering Dept., Vega Airplane Co., to become Educational Supervisor at Stinson Division, Vultee Aircraft, Inc. He had been Coordinator of the Military Division, Curtiss-Wright Technical Institute, before joining Vega.

**E. C. Saltzman** has been promoted from Junior Aeronautical Engineer to Assistant Mechanical Engineer with the Materiel Division of the Air Corps.

**Philip H. Schneck,** M.I.Ae.S., formerly Production Planning Supervisor for the Propeller Division, Curtiss-Wright Corp., is now a Captain in the Army Air Forces at Wright Field.

C.A.B. has announced the transfer of Air Safety Investigator **H. V. Shebat,** A.F.I.Ae.S., to Acting Senior Air Safety Investigator for the Safety Bureau at its Chicago office.

**H. W. Sibert,** A.F.I.Ae.S., Associate Professor of Mathematics and Aeronautics, University of Cincinnati, has reported for duty at Wright Field as a Major in the Air Corps Reserve.

**S. Thomas Simon,** M.I.Ae.S., of the General Counsel's Office, C.A.B., has been ordered to active duty as a Lieutenant in the Navy.

**Dean C. Smith,** M.I.Ae.S., Director of Sales for Curtiss-Wright Corp., Airplane Division, in the midwest region, has been named Director of Transport Contracts for the whole Airplane Division, with offices in Buffalo.

**Blaine K. Stevens** has recently transferred from the Airplane Division of Curtiss-Wright Corp. to Dow Chemical Co. where he is an Engineer in the Fabrication Division.

**Douglas W. Swanson,** a graduate of Aero Industries Technical Institute, is a Loftsman in the Engineering Dept. of Consolidated Aircraft Corp.

**Rear Admiral J. H. Towers,** M.I.Ae.S., has been given duties in addition to those as Chief of the Navy Bureau of Aeronautics by appointment as Assistant Chief of Naval Operations (Air). The latter is a new office created in the Navy Department to handle "all appropriate and duly assigned matters relating to naval aviation." The Naval Air Transport Service has also been placed directly under the authority of Admiral Towers.

**Carl B. Tracy** has joined the staff of The Glenn L. Martin Co. as Experimental Flight Test Engineer. He had been an Airline Operations Engineer for Pan American-Grace Airways in Peru.

The first professional degree in Aeronautical Engineering (Ae.E.) to be granted by the University of Detroit was conferred upon **George H. Tweney,** M.I.Ae.S., at commencement exercises last month. Mr. Tweney received the degree of B.Ae.E. from the University of Detroit in 1938 and has been an Instructor in Aeronautical Engineering there since January, 1941. He is now Acting Director of the Department of Aeronautics.

New President of Brewster Aeronautical Corp., announced on May 22 when the Navy Department returned the company to private operation, is **C. A. Van Dusen,** M.I.Ae.S. He had been a Vice-President of Consolidated Aircraft Corp. since 1935 and was with The Glenn L. Martin Co. from 1914 to 1934.

**Kurt Wagenknecht,** formerly in Production Planning for Brewster Aeronautical Corp., has joined the staff of the War Production Board in the Office of Progress Reports.

**John J. Walker,** formerly on the engineering staffs of Lockheed Aircraft Corp. and Vega Aircraft Corp., has been commissioned a 2nd Lieutenant in the Coast Artillery.

**Francis L. Wallace** has left United Air Lines, where he was an Airline Captain, to join American Export Airlines as a Pilot.

**Edward L. Weiss** is now a Draftsman with Vought-Sikorsky Aircraft Division, United Aircraft Corp., having previously held a similar position with Platt-LePage Aircraft Co.

**William A. Wichers** has been promoted from Meteorologist to Senior Meteorologist for Pennsylvania-Central Airlines and is stationed at Washington National Airport.

**Edmund G. Wodrich,** who was recently a Structural Designer, Northrop Aircraft, Inc., is now on duty with the Ordnance Dept., U.S. Army, as a 1st Lieutenant.

**Major Eric W. Wood,** M.I.Ae.S., President of Barry & Wood, Inc., is on active duty as Ordnance Officer at a U.S. Marine Corps Air Station.

**William F. Wright,** who held a teaching fellowship at Harvard Graduate School of Engineering for the term just ended, is now an Ensign, A-V(S), in the U.S. Naval Reserve, stationed at a Naval Air Station on the east coast.

**Corp. John Paton Young,** a graduate of Wentworth Institute, has been assigned to an Army Air Forces Pursuit Squadron.

The War Production Board announced last month the appointment of an Air Cargo Committee to make a special study of the situation in regard to increasing the manufacture of cargo airplanes. The Committee is giving particular attention at the beginning of its study to the problems of critical materials and the allocations necessary for an adequate cargo airplane construction program. Chairman of the Committee is Harold E. Talbott, Deputy Director of W.P.B., and Gerard B. Lambert, Chief of Liaison for W.P.B., is Executive Secretary. Committee members are William B. Harding, Vice-President, American Republics Aviation Division of Defense Supplies Corp.; Lewis Douglas, Deputy Director, War Shipping Administration; Col. Royal B. Lord, Assistant Director, Board of Economic Warfare; **Robert H. Hinckley,** Hon.M.I.Ae.S., Assistant Secretary of Commerce; **Dr. J. C. Hunsaker,** Hon.F.I.Ae.S., Chairman, N.A.C.A.; **T. P. Wright,** F.I.Ae.S., Assistant

Chief, Aircraft Branch of W.P.B. **Grover Loening,** F.I.Ae.S., has been appointed technical consultant to the Committee.

### Branch Award Winners

Each year the Institute gives awards to two Student Members of each Student Branch selected by the officers and members of the branch. The Lecture award is given to the senior student judged to have presented the best lecture before the branch during the school year. The Scholastic award is given to the senior student who had the highest scholastic record in his class.

A certificate of award signed by the President of the Institute and the Honorary Chairman of the particular Student Branch is presented to each recipient. He also receives, as an honorarium, prepayment of dues for Technical membership in the Institute for two years after his graduation from school.

The Student Branch Lecture Award winners for the year 1941–1942 are as follows: Eugene S. Davidson, Polytechnic Institute of Brooklyn; Karl Goettert, Casey Jones School of Aeronautics; Harry Flake, University of Cincinnati; Robert Mendelsohn, University of Detroit; James L. Fischer, Duke University; Bernard F. Shattuck, Harvard University; Myrvel A. Sorenson, Iowa State College; Jules F. Saut, University of Kansas; Leonard Edelman, Louisiana State University; Harold E. Carlson, Oregon State College; Raymond L. Zavasky, University of Pittsburgh; William A. Mueller, Rensselaer Polytechnic Institute; Donald Christopherson, Tri-State College; and Robert C. Wing, University of Washington.

The Student Branch Scholastic Award winners are: Paul A. Libby and Merven W. Mandel, Polytechnic Institute of Brooklyn; Morton A. Weiss, Casey Jones School of Aeronautics; Lee Cogwill, University of Cincinnati; Joseph Lee, University of Detroit; J. Edward Napier, Jr., Duke University; William E. Brown, Harvard University; Gibbs S. Raetz, Iowa State College; John L. Harkness, University of Kansas; E. P. Maske, Louisiana State University; Donald R. Jacoby, Oregon State College; Campbell C. Yates, University of Pittsburgh; Warren A. Tucker, Rensselaer Polytechnic Institute; Patrick L. Kelly, Agricultural and Mechanical College of Texas; Alfred A. Adams, Tri-State College; and Robert A. Nova, University of Washington.

Recipients of awards to be selected by other Student Branches will be announced later.

# Members Elected

The following applicants for membership or applicants for change of previous grade have been admitted to membership in the grades indicated since the publication of the list in the last issue of the REVIEW.

### Elected to MEMBER Grade

**Ashton, Robert,** Mgr., Aircraft Repair Factory, Brooklands Aviation Ltd., England.

**Clapp, Vernon Otho,** S.M.; Chief Meteorologist, American Export Airlines.

**Ellor, James Edwin,** Technical Advisor on Aircraft Engines, Packard Motor Car Co.; Chief Research & Development Engineer, Rolls-Royce Ltd., England.

**Hill, Harry Norton,** C.E.; Research Engineer, Aluminum Co. of America.

**Kolehmainen, Leo,** B.Ae.E.; Stress Engineer, Northrop Aircraft, Inc.

**Lahm, Frank P.,** B.S.; Brigadier General, U.S. Army (Retired); Rated Pilot and Technical Observer.

**Lawrence, Herbert Ronald,** M.A.; Stress Engineer, Northrop Aircraft, Inc.

**Lear, William Powell,** President, Lear Avia, Inc., and Lear Avia of Calif., Inc.

**Morvay, Anton Allan,** Dr. Eng.; Director of Research & Development, Aircraft Div., Mills Novelty Co.

**Sharp, John Wilfred,** Asst. to Project Engineer, El Segundo Div., Douglas Aircraft Co.

### Elected to Technical Member Grade

**Bergholt, Fred Bernard,** Owner, Bergholt Laboratories.

**Gelin, Carl Hilding,** Instructor, Curtiss-Wright Technical Institute.

**Goertzel, Gerald,** M.S.; Research Engineer, Republic Aviation Corp.

**Mazzari, Hugo Leopold,** B.S.; Inspector, Republic Aviation Corp.

**Peirce, Carroll Joseph, Jr.,** M.S. in Ae.E.; Instructor in Aero. Engineering, University of Michigan.

**Rubin, Norman Nehemiah,** B.S. in M.E.; Flight Analyst, C.A.A.

**Silverstein, Matthew,** Jr. Engineer, Stress Dept., Aero. Div., Snead & Co.

**Skelton, Eric,** A.R.Ae.S.; Technical Advisor, Aircraft Repairs, Design & Maintenance, Scottish Aviation Ltd.; Lecturer in Mathematics, Air Training Corps, Scotland.

**Speas, Robert Dixon,** B.S.; Research Engineer, Engineering Dept., American Airlines, Inc.

**Syddall, William Henry,** Service & Flight Test Engineer, Rotol Airscrews, Ltd., England.

**Thompson, Oscar Neil,** B.S. in M.E.; Stress Analyst, Consolidated Aircraft Corp.

**Wallace, Robert Drummond,** B.S. in Ae.E.; Aero. Computer, Lockheed Aircraft Corp.

### Transferred from Student to Technical Member Grade

**Adamovich, George William,** Draftsman & Designer, Pan American Airways System.

**Baggs, George M.,** B.S. in Ae.E.; Instructor in Aero. Engineering, Univ. of Minnesota.

**Baird, Roger Pryor, Jr.,** B.S. in M.E.; 2nd Lieut., U.S. Army Air Forces.

**Becker, Louis Frederick, Jr.,** B.S. in Comm.; Draftsman, Engineering Dept., Beech Aircraft Corp.

**Beckley, Lawrence Edward,** B.S. in Ae.E.; Research Asst., Div. of Industrial Cooperation, Mass. Inst. of Technology.

**Bedrosian, Edward,** B.S. in Ae.E.; Engineer, Consolidated Aircraft Corp.

**Berg, Carl, Jr.,** Tooling Engineer, Spartan Aircraft Co.

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## Necrology

### James Blackstone Taylor, Jr.

Lt. Commander James B. Taylor, Jr., M.I.Ae.S., a Founder Member of the Institute and well-known test pilot, was killed on May 25, 1942, when the Navy plane that he was flying went out of control and fell in swamp land near Woodbury, N.J. Commander Taylor was stationed at the Naval Aircraft Factory in Philadelphia.

Born in New York City, September 23, 1897, Commander Taylor was educated at Pomfret School and Princeton University, which he left in 1917 to join the Naval Air Service. He received flight training at the Naval Air Station at Bay Shore, Long Island, and was soon transferred to Miami, commissioned an Ensign and assigned to flight instruction. After the war he remained for several years with the Navy as a test pilot for the Bureau of Operations and then became an aeronautical consultant and test pilot in commercial aviation, meanwhile maintaining a commission as Lieutenant, U.S. Naval Reserve, and undertaking numerous assignments for the Navy.

One of the oldest test pilots in American aeronautics, he contributed much to the Navy's original experiments with catapult launching and deck landing of airplanes on ships, made experimental flights in such early planes as the Loening Kitten, Curtiss Wasp triplane, the Vought V.E.-10 flying boat, the Sperry Messenger and others. His dive tests on a Seversky Naval monoplane in 1937, in which he attained speeds of 500 to 600 m.p.h., attracted wide attention. He had tested more recent Curtiss and Grumman airplanes and has flown more than 500 different types of aircraft.

Commander Taylor was a founder and Vice-President of the Aviation Country Club at Hicksville, Long Island, and had been active in private flying and the organization of other aviation country clubs before the present war.

In 1927 he and Haven B. Page founded Air Associates, Inc., of which he was a Director until a few months ago when he resigned to go into military service. With B. W. Ainsworth he established the firm of aeronautical consulting engineers, Taylor-Ainsworth, Inc., in 1935 and acted as its President. He was also President of the Upressit Products, Inc., a metal-stamping company. Upon his return to active naval duty this year he was promoted to Lieutenant Commander and stationed at Floyd Bennett Field until his transfer to the Naval Aircraft Factory in April.

Commander Taylor was a member of the S.A.E., the A.S.M.E., the U.S. Naval

Institute, and the Royal Aero Club of London and was an Associate Fellow of the Royal Aeronautical Society of Great Britain.

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## Personnel Opportunities

This column is for the use of individual members of the Institute seeking new connections and organizations offering employment to aeronautical specialists. Any member or organization may have requirements listed without charge by writing to the Secretary of the Institute.

### WANTED

Engineering Instructors wanted by approved school in Midwest. Furnish qualifications, experience and snapshot in first letter. Address inquiries to Box 152, Institute of the Aeronautical Sciences.

**Aeronautical Engineer** experienced in plywood aircraft manufacturing wanted by southern aviation company. Must be able to take active charge of manufacturing and engineering operations. State experience and salary expected in first letter. Address Aviation Engineering, Inc., 1390 Blashfield Street, S. E., Atlanta, Ga.

**Two Draftsmen,** preferably with instrument experience, for work on confidential projects for Army and Navy having vital bearing on the War effort. Applicants must be able to satisfy F.B.I. regarding loyalty prior to starting work. Residence and work will be in small town on Long Island. It is anticipated work will be permanent. Address inquiries to Box 157, Institute of the Aeronautical Sciences.

**Instructor,** young, well-trained man with experience, capable of handling instruction in aircraft structural design and stress analysis wanted by Aeronautical Engineering Division of large eastern college. Salary $4,500. Must be American citizen. Send inquiries, giving education, experience and personal details, including small photograph, to Box 160, Institute of the Aeronautical Sciences.

**Airplane Designers, Stress Analysts, and Draftsmen** needed for few vacancies remaining on engineering staff. At least four years' experience essential. Release will be required if now employed in similar position. (Can also use one or two recent graduates for computation work.) Write for appointment stating education, experience, and salary. Snead & Company, Aeronautical Division, 421 Canal Street, New York, N.Y.

**Stress Analyst** wanted. Excellent opportunity with progressive Ohio airplane manufacturer engaged in defense. Take charge stress analysis to C.A.A. and possible later Army requirements. Good future and experience. Address inquiries to Box 162, Institute of the Aeronautical Sciences.

### AVAILABLE

**Aeronautical Engineer and Test Pilot** desires permanent and responsible position. Extensive aeronautical research and development experience with Government and major aircraft manufacturer. Training, including Master of Science degree, at leading engineering college. Particularly qualified in development and performance flight testing as applied to power plant installation development. Able to solve new engineering problems in practical manner. Inventive ability demonstrated. Location in Southern California preferred. Age 39. Address inquiries to Box 156, Institute of the Aeronautical Sciences.

**Graduate Aerodynamicist** with five years' diversified experience with major aircraft manufacturers desires new connection in aircraft development or engineering administration. Address inquiries to Box 158, Institute of the Aeronautical Sciences.

**Aeronautical Engineer** (B.S. in Ae.E., 1939), with three years' U.S. Navy experience in preliminary design, applied aerodynamics, and flight test procedure. Particularly qualified for position involving knowledge of Government methods in these fields. Location on West Coast with new or expanding concern preferred. Age 28. Address inquiries to Box 161, Institute of the Aeronautical Sciences.

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